SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME XLIX OCTOBER, 1929 NUMBER 4

THE ASSOCIATION OF ENDOMETRIOSIS WITH NEOPLASMS OF THE OVARY

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VERY little is known of the pathogenesis of endometriosis, despite the many investigations into its nature and origin. Several hypotheses have been put forward, but none of these is completely satisfactory.

Recently, the association of the condition with neoplasms of the ovary has been observed. This has suggested the idea that the endometrial abnormality may be the result of a hormone, abnormal either in amount or quality, arising in the ovary.

Particularly since some of the tumors appear to arise from the epithelial—and active—elements of the organ, the follicle and luteal bodies, this association is interesting. The following cases are considered worthy of record since various types of endometrial proliferation are here found associated with ovarian tumors. It is proposed to show that the ovarian tumors possibly bear a close causative relationship to the abnormal endometrium.

CASE 1. Miss F. W., aged 51 years. The patient complained of intermenstrual bleeding, which commenced suddenly 16 months previously. She had been operated on 32 years before, for a "growth" in the spinal region. For the last 9 years she had had ascites, which has been tapped at intervals. She had also had attacks of angina pectoris. Menses had not ceased when the bleeding commenced. This was very severe. She had been in bed for 10 months because of weakness.

Her general condition was very poor, extreme anæmia being present. A very irregular knobby mass was felt in the suprapubic region arising from the pelvis and reaching halfway to the umbilicus. Marked enlargement of the uterus (myomata) was observed. Radium was inserted into the uterus to control the hæmorrhage. The patient improved sufficiently for an operation to be performed. Panhysterectomy was performed 1 month later.

Pathological examination. The specimen consists of the uterus, fallopian tubes, and both ovaries. The uterus was two to three times larger than normal—measuring 7 inches by 3½ inches by 3½ inches (taking the average measurements), of hard consistency, and irregularly lobulated (Fig. 1). The fallopian tubes showed several small lobulations at various positions along their lengths. The right ovary was slightly enlarged—1¼ inch by ¾ inch by ¾ inch, being irregular in shape; the irregularities were due to multiple cysts. The left ovary was smooth, solid, and measured 1½ inches by 1 inch by ¾ inch.

Macroscopic examination. The uterus showed (Fig. 2) multiple myomata and on the cut surface of these could be seen small slits and spaces. These tumors showed the whorling (Fig. 3) which is so characteristic of the adenomyomata and which differs from that of the ordinary myomata in being of a much finer type. Posterior to the cavity of the uterus, there was a large glandular space forming a "small uterine cavity," a space lined by epithelium and having no connection with the uterine cavity proper. The cervix showed marked cystic dilation of the glands, and some sections revealed a number of small spaces similar to those visible in the uterus. The right ovary showed multiple small cysts of varying size and shape, some of which contained blood. The left ovary showed the organ to be replaced, almost completely, by tumor (Fig. 4), only

a thin rind remaining. The growth was soft and had radiating clefts in it.

Microscopic examination. The spaces in the uterus were typical, endometrial gland-like spaces, with the surrounding characteristic stroma (Fig. 5). While most of these tumors were, thus, adenomyomata, one or two showed no evidence of aberrant epithelium. Near the central part of the uterus, the epithelium was degenerated, and the connective tissue had undergone hyaline change. This was considered to be the effect of the previously inserted radium. The larger spaces and cysts in the region of the cervix showed epithelium of the cervical type, but most of the smaller spaces were typically endometrial in character. Section of the nodules in the fallopian tube showed small areas of endometrial tissue at some distance from the cavity of the tube, and two of them were followed by serial section to demonstrate their independence of the mucous membrane of the fallopian tube. The cysts in the right ovary were mainly lined with a single layer of cells, but some were obviously developed from graafian follicles. One or two showed proliferative activity of the cells. This activity of graafian follicles, in similar cases, has been previously remarked elsewhere (12).

The tumor in the left ovary presented curious characters, which differed in various parts. It showed: collections of cells resembling the structure of a graafian follicle (Fig. 6); massive papillary development into large cystic spaces (Fig. 10); solid carcinoma with blood spaces lined by cuboidal cells (Fig. 7); typical spheroidal carcinoma in one small area (Fig. 8); and in some portions, the growth showed a considerable amount of hyaline material which closely resembled that of a corpus albicans (Fig. 9).

Case 2. Mrs. B. H., widow, aged 62 years. The family history revealed nothing of note. She had had an operation for fibroids 18 years previously. There had been a suppression of menses at this time, but these had recurred for a period of 12 months after the operation.

Three weeks before admission, she had noticed a swelling in the lower abdomen associated with a slight hæmorrhage *per vaginam*. Six days later, she had a severe hæmorrhage. This lasted 3 days and there was an offensive odor. She had lost no weight and felt well. The abdomen showed the scar of the previous operation. There was a soft mass in the hypogastrium, a little more on the right side. A large tumor was palpable, felt bimanually, in the right and posterior fornices.

At operation it was found that a large cyst replaced the right ovary. The cyst was somewhat adherent to the uterus, the anterior abdominal wall, and the pelvic wall. Removal was performed with difficulty.

Pathological examination. The uterus was, macroscopically, apparently normal. The large cyst which replaced the ovary on the right side was about 4 inches in diameter and contained dark fluid blood and old clots. One side of the cyst wall was thickened.

Microscopic examination. The uterine mucosa showed marked hyperplasia, though there was no undue invasion of the muscle coat. Section of the thickened portion of the wall of the ovarian cyst showed carcinomatous tissue of the same type as in Case 1 (Fig. 12). The cells were small, with relatively large, deeply staining nuclei. They were arranged in large masses. In some places the groups of cells were embedded in hyaline tissue. Cells of the same kind also lined the cavity of the cyst (Fig. 11).

The tumors in both of these cases, for reasons to be given subsequently, were considered to be granulosa cell tumors. A further case is of interest since the aberrant endometrium is associated with an ovarian tumor growing in a luteal cyst.

Case 3. Mrs. F. L., aged 45 years. She complained of pain in the lower abdomen for the previous month. She had had two children, both alive and well. The younger was aged 15. She had not felt well for the previous 4 months. At her last menstrual period, 1 month ago, she had lost more than usual. During this period, and for the recent month, she had had a bearing down pain in the lower abdomen, which was worse on the right side than on the left. There had been pain across the back in the sacral region for a "long time." She had also had an intermenstrual discharge for years. She was constipated particularly during the periods. Micturition was normal. She thought that she had been losing weight.

There was a mass in the hypogastric region; movable, tender, and reaching to the umbilicus. A smaller mass was palpable in the right iliac fossa; hard, tender, and causing pain down the right thigh. The masses were felt here and diagnosed as uterine myomata and cyst of the right ovary respectively. There was a thickening behind the cervix extending into the rectovaginal septum. This was provisionally diagnosed as adenomyoma of the rectovaginal septum. A panhysterectomy (block dissection) was performed.

Pathological examination. The large irregular uterus contained multiple myomata. Behind the cervix there was a small piece of tissue resembling a myoma but containing spaces. The cyst of the ovary, 3½ inches in diameter, contained old blood (chocolate material) and had papillary masses growing into its cavity.

Microscopic examination. The postcervical mass showed typical endometrial glands throughout the tissue (Fig 4). The myomata were, unfortunately, destroyed before microscopic examination was made. The chocolate cyst showed atypical luteal tissue in its wall. The papillæ were typical of those seen in a papilliferous cyst of the ovary (Fig. 15).

All of these cases have in common the presence of an obvious ovarian abnormality—a neoplasm. Also, the association of an ovarian tumor with uterine bleeding is noteworthy. This immediately directs attention to the condition of the endometrium, which was, in all these cases, pathological, showing either local hyperplasia or proliferation in abnormal situations. In Case 2 there is merely a hyperplasia of the endometrium in its normal situation, which is striking, however, in consideration of the age of the patient. In Case 1 there was an extensive involvement of the uterus and to a less extent the fallopian tubes with aberrant endometrial glands. Case 3 presents endometrial glands in the rectovaginal septum.

It has been suggested by Meyer and Neumann that the stimulus responsible for aberrant endometrial growth may be found in the diseased ovary. Several cases have been reported showing a relationship between ovarian growths and hyperplastic or heterotopic endometrium. Schroeder reported a granulosa celled tumor associated with grandular hyperplasia, which in some degree suggested carcinoma, and Tietze showed the relationship of a similar growth to both hyperplastic and to aberrant growth of endometrium.

The exact pathological status of endometriosis—whether it be a true blastoma, an inflammatory condition due to a migration of tissue from the normal endometrium, or other cause, is still undecided. None of these hypotheses is satisfactory, but from several points of view, the suggestion that one of the exciting factors is hormonal, from the abnormal ovary, is very attractive. Even if we could show that the disease of the ovary was in a casual manner related to these conditions of endometriosis, there must still be some other factor or factors which determine the exact site and nature of the growth.

A study of the physiological relationships of the functional portion of the ovary (particularly the corpus luteum) with the endometrium has demonstrated an extremely close association, both in menstruation and pregnancy. The changes in the endometrial stroma are particularly interesting. At these times the stroma cells swell and form characteristic decidual cells. It has been shown, recently, that these cells occur not only in the endometrium, but among other places in the peritoneum, fallopian tubes, and bowel. This occurs in menstruation as well as pregnancy. It is unknown why certain cells and not others should be affected by what seems undoubtedly to be a hormone arising in the ovary; the reason for and the nature of this discrimination is at present a complete mystery.

Fig. 1. Case 1. The specimen of uterus, fallopian tubes, and ovaries as removed at operation. The uterus is irregularly enlarged, showing multiple adeno-myomata (Compare with Fig. 11). The nodules in the fallopian tubes showed, on section, aberrant endometrial tissue. The right ovary contains many small cysts, while the left is uniformly enlarged. (See Fig. 4.)

The distribution of these aberrant decidual cells is very similar throughout the body to that of endometriosis. The relationship, if any, that these decidual cells bear to heterotopic endometrium is unknown, but the similarity of distribution suggests that there is some connection. Since the decidual cells are closely associated with ovarian activity, the presence of some ovarian abnormality in cases of endometriosis is very suggestive of a common causative factor between the two.

In the type of case under discussion, there is an obvious pathological lesion—a neoplasm. Later, it is possible that other diseases of the ovary may be shown to produce similar endometrial change.

The consideration of the type of ovarian neoplasm with which these endometrial conditions are associated is important.

Fig. 2. Case 1. A median sagittal section of the uterus. Multiple tumors are present containing many small gland-like spaces in the muscle tissue. The uterine cavity is cut only in part, owing to deformation due to the presence of the tumors. The space posterior to this is a small "uterine cavity" not having any connection with the central cavity of the uterus. Cystic dilatation of the glands in the cervical region is present.

Fig. 3. Case 1. Photograph of a sagittal section of the uterus, parallel to that shown in Figure 2. The fine whorling which is characteristic of "adenomyoma" is seen.

In two cases (Cases 1 and 2) there was a typical granulosa-cell tumor. The reasons for so describing these tumors are that the cells resembled in the shape and the staining qualities of their nuclei, the cells of the granulosa layer of the graafian follicle (Fig. 7); in a considerable part of the tumor they were arranged in small groups resembling the adult follicle (Fig. 6); in other parts the massive arrangement of the cells was like that of the follicle; small spaces resembling the Call and Exner bodies were frequent throughout the tumor (See Fig. 12); the formation of spaces resembling the theca folliculi were frequent (Fig. 11). The presence of blood vessels throughout the tissue was unlike the true stratum granulosum, but this occurrence of vessels among epithelial cells is common in epithelial neoplasms. Tumors of this nature have been described on several occasions (11, 13, 15, 17, 18, 20, 22, 23, 27).

A considerable amount of hyaline tissue was present among the groups of cells, constantly reminding one of corpora albicantia. It is possible that cells so closely related to the luteal cells—being allied to their progenitors—may cause a change in the connective tissue similar to that produced in the aging corpus luteum.

In describing these neoplasms as granulosa-cell tumors, it is not meant to infer necessarily that they arise from the cells of a graafian follicle but rather that they possibly come from cells in the ovary which are the progenitors of these follicular cells. As has been stated, the neoplastic elements themselves resemble the cells of the graafian follicle, and since this is so, the cells may possibly function in a manner similar to those of the corpus luteum. This opens up a most interesting avenue of research.

Fig. 4. Case 1. Section of both ovaries. The right shows numerous small cysts; the left shows the tumor which has replaced the ovarian tissue almost entirely.

Fig. 5.

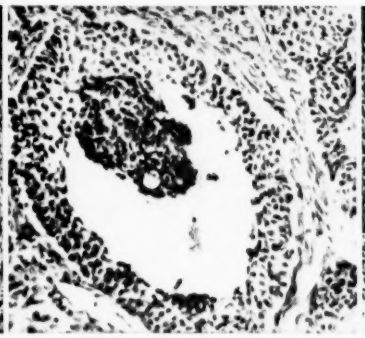

Fig. 6.

Fig. 7.

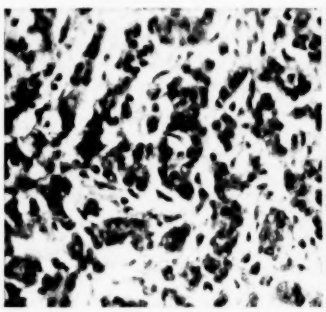

Fig. 8.

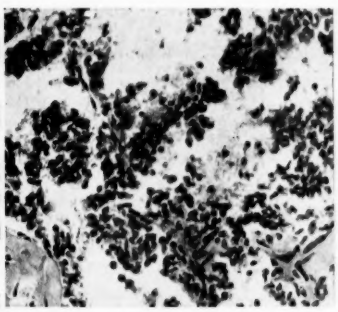

Fig. 9.

Fig. 10.

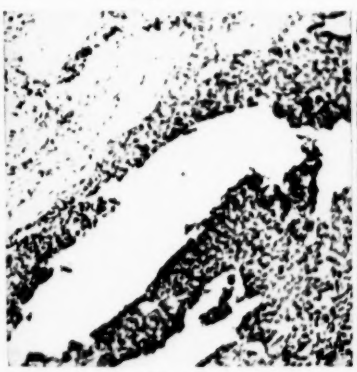

Fig. 11.

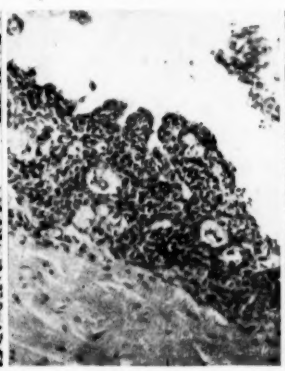

Fig. 12.

Fig. 13.

Fig. 5. Case 1. Section of portion of one of the tumors of the uterus, showing typical glandular structure. × 110.

Fig. 6. Case 1. An alveolar area, characteristic of a considerable portion of the tumor. The space very closely resembles a graafian follicle. × 150.

Fig. 7. Case 1. A portion of the solid part of the tumor, showing a blood space lined by cuboidal cells. × 160.

Fig. 8. Case 1. A small portion of the tumor showed typical spheroidal carcinoma. × 400.

Fig. 9. Case 1. A portion of the tumor, showing a loose alveolar structure. The hyaline supporting tissue occurred throughout a large part of the tumor. × 250.

Fig. 10. Case 1. A projection of a solid mass into the central space of the tumor. × 65.

Fig. 11. Case 1. Formation of spaces among the cells. This occurred throughout a large part of the tumor. × 150.

Fig. 12. Case 2. Portion of the wall of the cyst in the ovary, showing the cells lining it. These cells resemble those of a graafian follicle, and small spaces are present resembling the Call and Exner bodies. × 180.

Fig. 13. Case 2. The typical appearance of the tumor at the thickened part of the cyst wall. The cells are of the granulosa type; hyaline nature of the connective tissue is seen in the lower portion of the section. × 110.

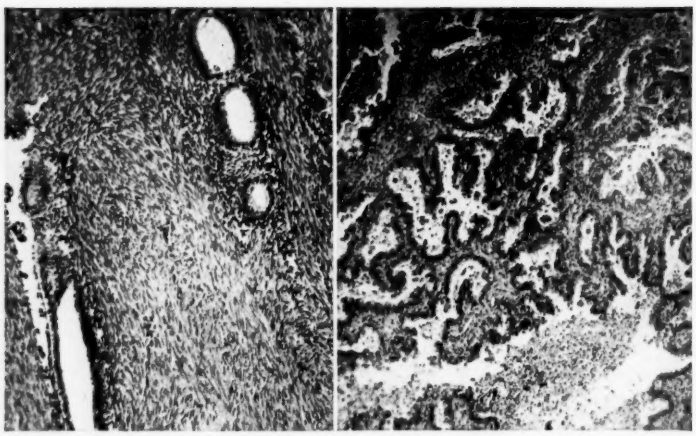

Fig. 14 (left). Case 3. The section shows the glandular structure in the muscle of the tissue of the rectovaginal septum. × 110.
Fig. 15. Case 3. A section of the papillary growths into the chocolate cyst. × 200.

A considerable number of facts are already in our possession. The contents of follicular cysts have been shown, in animals, to contain material which may largely replace the internal secretion of the ovaries (1, 2, 3, 4, 8). The degree of the effect of the hormone on the endometrium and upon the epithelium of the vagina is considerable. These and similar observations have been made by several observers (5, 6, 7).

In the lower animals, the amount of secretion waxes and wanes with the activity of the follicles, but in the primates the amount of internal secretion is maintained by the cells of the developing corpus luteum (1, 9). It has been suggested that this is the explanation of the difference between the menstrual cycle of the higher animals as compared with the œstrus cycle of the lower mammals.

However this may be, there is a hormone arising in the follicle which is closely related to the internal secretion of the corpus luteum (10).

Both these secretions have a specific stimulating effect on the endometrium. It is, therefore, probable that tumors consisting of cells which are closely allied to the granulosa cells —and, therefore are presumably capable of producing the follicular hormone—which may be abnormal either in amount or quality—may have a considerable effect on the endothelium. This effect, in these cases, is apparently to cause overgrowth.

There is also another factor. It has been shown that embryonic tissue possesses some of the hormone and thus the tumor which is essentially cells of an anaplastic type may contain additional amounts of the hormone in question.

In the other case (Case 3) there is a tumor arising in a luteal cyst. It is considered that this arises from the heterotopic epithelium which occurs in luteal cysts, and Shaw has described such a case and has given this suggestion. The author has also reported a case of carcinoma arising in such a cyst, and reasons for considering that the origin was from these same cells were given.

The origin of these cells has also been discussed. Shaw considers that they arise by metaplasia from endothelium; the writer considers that they possibly arise from luteal cells.

When we consider that the cells of the granulosa layer of the graafian follicle develop into the cells of the corpus luteum, it is not surprising that the tumors under discussion should have similar functional associations. Further speculation in this direction is, however, futile until the origin of the cells lining luteal cysts is beyond doubt.

More material is also necessary before adequate and justifiable deductions can be made concerning the relation of these growths occurring in the ovary to hyperplastic and heterotopic endometrium.

SUMMARY

1. Three cases of ovarian tumor associated with abnormal endometrium are described.

2. Two of the tumors are granulosa-cell tumors and a third arises in a luteal cyst.

3. The possible causative relationship is discussed.

Grateful acknowledgment is due to Mr. R. Fowler for the specimens and the notes of the cases, to Dr. J. Fiddes for the drawings, and to Mr. E. Burt for serial sections made of Case 1.

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RADIUM STERILIZATION OF THE FEMALE ALBINO RAT (MUS NORVEGICUS)

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THE Gynecean Hospital Institute of Gynecologic Research of the University of Pennsylvania is making a clinical study of the effects of pelvic irradiation in women upon the health and development of subsequent offspring.

A review of the literature dealing with the health and development of animal and human offspring has already been published in this connection (4). In addition, a report has been published, which summarizes the existing information concerning experimental ovarian irradiation (3). Other clinical studies of a related nature have just been completed (5).

Extensive animal experiments are being conducted, parallel with the clinical investigation, to determine the influence of pelvic radium and roentgen irradiation of the female albino rat upon the health and development of their subsequent progeny. In these experiments radium is employed *before* while roentgen rays are used *after* conception.

The consequences of *preconception radium irradiation* will be reported in two installments. This paper (the first installment)concerns the amount of radium exposure necessary *to sterilize* the female rat permanently. The second report will deal with the reproductive powers of the animals which were not sterilized by the irradiation and the health and development of the offspring of the fertile animals, as they may have been affected by the previous maternal irradiation.

For the purpose of this study, the *sterilizing radium exposure* is defined as the amount of irradiation which will inhibit reproduction, in the case of any single animal, for at least 4 months following the treatment and mating of that animal. If it is assumed that the life cycle of the rat is consummated in $^1/_{30}$ of the time required for the human life cycle, as stated by Donaldson (1), then 4 months of sterility in the rat is equivalent to 120 months (10 years) in the human being. Since 10 years' sterility in the case of the latter usually means permanent sterility, its equivalent of 4 months for the rat is here taken as permanent.

At the beginning of the investigation it was further decided that if sterilization of all the animals receiving a certain dosage was not accomplished, then the term "sterilizing exposure" would be used as indicating the amount of irradiation which would sterilize at least 60 per cent of them.

A standard sterilizing dose is necessary as a relative measurement for the *substerilizing* and *maximum substerilizing* doses. The experiments with these smaller doses are treated in the second installment of this report, which will be published in the near future.

One hundred and twenty-eight albino rats were subjected to radium exposure of the ovaries, the radio-active substance being applied on the body surface. As is shown in the accompanying tables, exposures of various durations were given to the different groups of animals. The doses employed were sufficiently large to kill many of the animals. Of those surviving the treatment, the majority had been rendered sterile, while a few cast litters in spite of the irradiation. The technique of the irradiation, the amount of exposure used, and the influence of the treatments upon the reproductive function of the animals form the basis for this report. It must be pointed out, however, that the object of the experiments related here was only to determine whether the irradiated animals could subsequently reproduce or not.

We have adopted this functional standard in preference to judging the sterilizing effect of the radium from a less definite *histological* point of view, and this mainly for the two following reasons: (1) The appearance of the young ones is the best index of the power of reproduction and the surest means of its accurate determination. (2) It was necessary to maintain the entire rat colony for a considerable length of time in order to study the

influence of irradiation upon the health and development of later offspring.

The series of radium treatments, outlined below, was begun in November, 1927, and carried over a period of nearly a year. The *radium exposures* were all given in the Radium Research Laboratories of the Philadelphia General Hospital, through the courtesy of the Cancer Research Committee of that institution. The rest of the experimental work was carried out in the laboratories of the Gynecean Hospital Institute.

MATERIAL AND METHODS

Virgin albino rats, at the optimum breeding age of 120 days (2), were used in all experiments. The animals were procured from the Wistar Institute of Anatomy and Biology just prior to the time of treatment.

The rat was selected chiefly because it could be secured from healthy parasite-free stock, with pedigree of many generations. The known pedigree was considered of special value for the later part of the study, i.e., the part dealing with the influence of irradiation upon the health and development of the offspring. The freedom from parasitic infestation was also important, as the anæmia, frequently associated with parasitic infestation in the rat, often is the cause of sterility.

Virgin animals were selected in order that all litters born immediately after irradiation should be first litters, thus eliminating the factor of variation due to differences in the sequence of pregnancies. Furthermore, according to Duhring, less than 2 per cent of the 120 day old virgin rats from the Wistar Institute Experimental Rat Colony are found to be sterile. Pre-existing sterility in these animals need not, therefore, be seriously considered.

The age of 120 days was chosen, since this has been demonstrated (in the Wistar Institute Colony) to be the optimum breeding age in rats.

All animals were received in a healthy condition, and by careful management we succeeded in maintaining the colony without serious losses from pulmonary or intestinal infections, the two most common causes of death in the laboratory rat.

The animals were housed in metal cages with wire-gauze floors, which permitted immediate escape of all excreta, especially urine. As a result, the animals were kept dry at all times, and, thus, the danger of chilling was minimized and the death rate from subsequent pneumonia kept low. In addition, the room temperature was kept above 68 degrees Fahrenheit throughout the colder months of the year. The cages were cleaned daily, in order to keep the number of parasitic vermin as low as possible. Cages found to be infested were immediately sterilized in boiling water.

The animals were kept supplied with food at all times. Fresh food, both raw and cooked, was prepared daily. Green vegetables were fed at least twice a week and were the only uncooked foods in the diet, lettuce being the one most commonly given. In order to remove all parasitic ova, the green vegetables were thoroughly washed and the rest of the foods were thoroughly cooked. The diet varied from day to day, usually cornmeal or hominy grits being used as its basis. To these were added tomatoes, salmon, beans, peas, fresh meat with bones, and fresh fish. The colony received fresh meat or green vegetables of some kind practically every day. The care of the animals and the attention to diet were necessary to maintain the colony on a healthy condition throughout the experiment and to give optimum conditions for breeding. The varied and full diet, as briefly outlined above, was used in order to ensure a constant and full vitamine supply, a deficiency of which is known to favor sterility in the rat.

Radium was selected as the source of irradiation because of its frequent use in gynecologic practice, and also because a relatively large supply (2 grams) was available in the Laboratories of the Philadelphia General Hospital. Furthermore, this element had not been so frequently used in earlier experiments with ovarian irradiation in the lower animals.

The radium was available in the form of emanation or radon. This has the advantage over the radium salt that it can be condensed into a smaller volume, thus making it possible to bring the radiant source closer to the object to be irradiated.

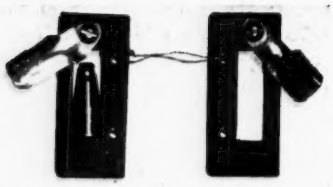

Fig. 1. A pair of bakelite holders with hinged copper covers used for maintaining the radon capsule in close approximation to the rat's back. The thickness of the bakelite was made less than the width of the brass capsule (8 millimeters). The hinged cover was also made shorter than the opening in the bakelite. These two construction details made possible a close approximation of the capsule to the animal's body.

Approximately 500 millicuries of radon, in a single radon-containing capsule, were employed for each series of animals treated. It was possible to use this large amount of radon in the treatment of most of the animals, thus making the necessary period of exposure comparatively short. The radon was measured by means of an electroscope both before use and after the completion of any series of treatments. This made possible an accurate estimation of the value of the radon used and was a check on the possible loss of emanation during the experiment.

A brass capsule was used to hold the radon-containing glass tubes and to filter out the alpha and beta rays (Fig. 1). It was 20 millimeters long, 8 millimeters in outside diameter, and 2 millimeters in thickness. The radon tubes were 14 millimeters long.

Dissections and frozen sections of the entire rat's body showed the ovaries to lie approximately 1 centimeter beneath the skin surface at a point about 1.5 centimeters lateral to the midspinal line and an equal distance caudal to the lowest rib. In all of the radium treatments an attempt was made to center the brass capsule over this point.

The rat was held at full length in the hands of an assistant, care being taken not to change the normal relationship between the rat's skin and the underlying structures. The lower thoracic and lower abdominal regions were then snugly enveloped in bands of zinc-oxide adhesive plaster (Fig. 2). This was done in order to limit the voluntary movements of the rat during the period of radium exposure, which in most cases lasted the best part of an hour, and also to facilitate the application of the pair of bakelite holders (Figs. 1 and 2) used to maintain the accurate approximation of the radium capsule to the rat's back. When the bakelite holders were firmly in place, the brass capsule containing the radon was placed in the holder on the right side of the rat's body, and the hinged cover was brought into position over the capsule to hold the latter firmly against the underlying skin and hair. The animal was then placed in a wire basket for the desired time of exposure. At the end of this time the radon containing capsule was removed, and placed in the holder on the left side for an equal period, after which the rat was removed to her cage. Each rat, therefore, received two exposures, the first one over the right, and the second over the left ovarian region, immediately following the first.

Four of the animals reported upon in the present study were mated 6 days after irradiation, but the remaining 124 rats were not mated until 14 days after treatment. The 14 day interval was finally decided upon for several reasons. First of all, we wished to make sure that, should young ones be born in spite of the irradiation, they would result from fertilization of *ova present in the ovary* at the time of the treatment and not of ova which might have been in the oviducts at that time. Since it has been observed by others that the ova may live in the oviducts for 3 or 4 days, it was believed that at least 7 days should be allowed to pass before mating. Secondly, it was observed that the first local response of the rat's skin to the irradiation did not manifest itself until about the fourteenth day following irradiation. At this time alopecia developed in the treated area in most instances. It was presumed, on no other grounds than the above, that the ovaries might also show the first and perhaps most active response to the irradiation on or about the fourteenth day. It was, therefore, believed that ova fertilized at or about this time would more likely have been damaged by the irradiation than would ova fertilized at an earlier date. Another reason for allowing a lapse of 14 days between treatment and mating was the fact that most

women, giving birth to children after preconception pelvic irradiation, do not become pregnant at once (4). A 14 day interval in the case of the rat would correspond approximately with a 14 month interval in the case of a woman.

Table I shows the number of animals which received preconception ovarian irradiation, arranged according to amount of exposure. The first attempts to bring about sterility were made with the smallest exposures. When these failed the doses were increased until definite sterilizing effects were secured. The large number of animals receiving 450 millicurie hours of exposure over each ovary were so treated in order to secure a large number of subsequent offspring for a study of the influences of the maternal irradiation upon them.

Table II shows that of 128 irradiated animals 19 died before mating. These deaths were apparently all due to the irradiation rather than to other causes, a severe diarrhœa preceding death in all cases. No fatality occurred after the smaller doses of radium exposure. The larger the dosage, the higher was the death rate. It will be observed that only 109 out of 128 irradiated rats were actually mated.

Table III shows that 15 animals died within 4 months after mating. Thus, only 94 of the 128 irradiated animals lived for 4 months or more following mating. Furthermore, it will be observed that these deaths followed the larger amounts of radium exposure. It is assumed, therefore, that they were the direct result of the irradiation, since marked losses of weight and diarrhœa were observed in many instances. These were more frequent and severe after the larger exposures. Of the 15 animals just mentioned, 3 were found to be pregnant at death, while the remaining 12 were sterile.

The sterility frequency of all mated animals, irrespective of how long they lived after mating, was found to be as follows: Of 109 mated animals, 51 (approximately 47 per cent) were observed to be sterile at death or were sterile for 4 months after mating, while 58 (53 per cent) were observed to be fertile. These figures include the 15 animals which died within 4 months of mating time. Table IV

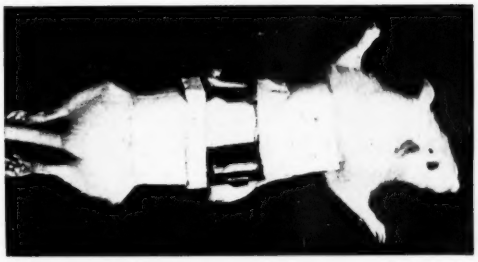

Fig. 2. Radium holders strapped to back of rat, in position for ovarian irradiation. Note capsule present in the right holder.

shows that of the 94 animals which lived for 4 months, 39 were sterile at the end of that period, constituting a sterility percentage of approximately 41. This approximates that of the entire group (47 per cent) of the irradiated and mated animals. It would seem, therefore, in a consideration of the sterility frequency of the mated animals, that the animals which died before the end of the 4 month period might well be included in the grand total.

It will be observed in Table IV that radium exposures of less than 450 millicurie hours had no appreciable influence upon fertility with the one exception, nor did they have any appreciable effect upon the death rate after mating (Table III).

Among 28 animals which received less than 450 millicurie hours of treatment (Table II) no death occurred before mating and only one after mating (Table III). Of the remaining 27 animals only 4 were sterile, representing a sterility frequency of only about 14 per cent.

In 81 animals which received 450 millicurie hours of irradiation or more (Table II) 19 deaths occurred before mating and 15 after mating (Table III). The remaining 47 cast only 12 litters, which gave a sterility percentage of approximately 74.

Thus, exposures of 400 millicurie hours and less gave a 14 per cent sterility against a sterility of 74 per cent where 450 millicurie hours or more were employed, excluding all deaths.

This study has brought out the fact that there is a wide difference between the amount of ovarian radium exposure necessary to sterilize a woman and the amount which will sterilize the rat. An accurate estimate of this

TABLE I.—THE NUMBER OF ANIMALS TREATED WITH THE VARIOUS AMOUNTS OF IRRADIATION.

Animals	Mc. hrs.
1	200
2	300
10	350
15	400
50	450
16	500
3	550
13	600
18	650
128	

The amounts of exposure, expressed in millicurie hours, refer to the sizes of the treatments that were directed at each ovary separately. Each animal, therefore, received twice the exposure given to one ovary. The largest group was given 450 millicurie hours of irradiation, in order to secure a large number of offspring for the subsequent part of the experiment.

TABLE II.—THE NUMBER OF IRRADIATED ANIMALS WHICH DIED BEFORE THEY COULD BE MATED, ARRANGED ACCORDING TO THE AMOUNT OF IRRADIATION.

Animals	Mc. hrs.	Treated	Dead
1	200	1	..
2	300	2	..
10	350	10	..
15	400	15	..
47	450	50	3
14	500	16	2
2	550	3	1
4	600	13	9
14	650	18	4
109		128	19

Note that no deaths occurred until at least 450 millicurie hours of exposure had been given, and that the death rate was extremely high (69 per cent) when 600 millicurie hours were employed.

difference is difficult, largely because of variations in techniques employed.

Human treatment is usually given by means of a single application in the uterine cavity, at a point mid-way between the ovaries. In the case of the rat it was found best to irradiate each ovary separately, through the body wall.

Although women vary considerably, one from the other, in their response to ovarian irradiation, for the purpose of this study it is assumed that 1,000 millicurie hours of intrauterine treatment will sterilize most women so exposed. It is further assumed for purposes of estimating dosage, that the human ovaries usually lie approximately 2½ inches (6.25 centimeters) from the center of the uterine cavity.

According to the "law of inverse square," if the rat ovary lies only 1 centimeter beneath the skin surface, as has been previously stated, no more than 27 millicurie hours of exposure would be necessary to produce sterility. As a matter of fact, the sterilization dose for one rat ovary was found to be in the neighborhood of 650 millicurie hours of exposure. This is approximately 24 times the amount of treatment necessary to sterilize a human being. If the *total amount* of millicurie hour dosage only is considered, omitting from consideration the other factors such as the distance of the radium from the ovaries, the number of exposures, etc., it will be seen that 1,300 millicurie hours of treatment were required to sterilize the rat, as compared to 1,000 millicurie hours for women. The rat, therefore, actually required more exposure than the human, though many times smaller than the latter.

It is shown in Table IV that not one of the 13 animals (Table I) which received 600 millicurie hours of treatment cast a litter. However, only 2 of them survived the irradiation, while 5 first litters were observed among the 13 animals which lived 4 months and received the still large dose of 650 millicurie hours.

If we consider as one group the two series of animals subjected to these high exposures (600 millicurie hours and 650 millicurie hours) we observe the following: Of 31 animals, 13 died before mating and 3 after mating. Fifteen animals survived. Of these 10 (66 per cent) were sterile. Thus, because two-thirds of the surviving animals were subsequently sterile, the sterilizing exposure for the rat, as employed in this series of experiments, is taken to be in the neighborhood of 650 millicurie hours.

DISCUSSION

From the foregoing we conclude that absolute sterilization of all rats could not be accomplished by even the largest amounts of irradiation. It would seem that this was dependent upon a number of factors, most of which were no doubt beyond control. First, the peri-ovarian fat may have varied in amount, from animal to animal, thus causing a variation in the distance between ovary and radium. Second, the position of the radium

TABLE III.—THE NUMBER OF IRRADIATED ANIMALS WHICH WERE MATED AND THE NUMBER OF THESE WHICH DIED WITHIN 4 MONTHS OF MATING.

Animals mated	Mc. hrs.	Dead
1	200	..
2	300	..
10	350	1
15	400	..
47	450	5
14	500	5
2	550	1
4	600	2
14	650	1
109		15

Of the dead animals 12 were found to be sterile, and 3 were pregnant at death—2 of the latter had 500 millicurie hours each, and the third 650 millicurie hours over each ovary. Note that deaths after mating were not frequent until 450 millicurie hours of irradiation had been administered.

TABLE IV.—THE FREQUENCY OF STERILITY IN IRRADIATED ANIMALS WHICH LIVED 4 OR MORE MONTHS AFTER MATING, ARRANGED ACCORDING TO THE AMOUNT OF IRRADIATION.

Animals mated	Mc. hrs.	Sterile	Per cent
1	200	..	...
2	300	1	50
9	350	1	11
15	400	2	13
42	450	22	52
9	500	3	33
1	550	..	...
2	600	2	100
13	650	8	61
94		39	

With the exception of the 2 animals which received 300 millicurie hours of treatment over each ovary, there was no marked increase in sterility until 450 millicurie hours of irradiation were reached

applicator in relation to the ovary may have been altered by inaccurate application of the bakelite holder (Fig. 2) to the dorsum of the rat. This is unlikely, however, as every effort was made to prevent any variation in this respect. Thirdly, in changing position in the basket during treatment, the rat may have altered the relative position of the radium.

In addition to variations due to these mechanical influences, the reproductive powers of the animals may have varied due to conditions less easily explained.

The systemic or the local effects of the radium treatments may have had some influence upon fertility. Following the shorter exposures, no appreciable systemic effects were observed, while the larger amounts of irradiation would cause evident loss of weight. Weekly weighings of a number of animals, receiving 450 millicurie hours or more, showed the weight loss to amount to as much as one-fourth of the pre-treatment weight. This decline was as a rule observed within one week of the time of treatment, usually reaching its maximum by the end of the fourth week. In most instances the weight would gradually return to normal in the course of 8 or more weeks. This considerable loss of weight, in certain cases, was associated with diarrhœa.

It is reasonable to suppose this systemic effect of the irradiation may have played a rôle in altering the fertility of the animals, although the promptness with which many of them became pregnant after irradiation would indicate the contrary.

According to the amount of exposure, the local response of the rat's body to the irradiation varied from simple depilation to the production of extremely large and deep ulcers. In most cases these ulcers healed but, as a rule, only after many weeks' duration. Several of the ulcers penetrated the entire thickness of the body wall, but in only one instance at autopsy was the burn found to involve the underlying tube and ovary. The burns were severe enough to produce paralysis of the hind extremities in four cases. In two of these, microscopic section indicated that the underlying spinal cord had been completely destroyed.

The question arises as to whether the effect of the radium upon the reproductive function was due solely to its direct action on the ovaries, or partly to its indirect systemic influence as well. It has also been suggested that, perhaps, the local ulceration of the body wall in many cases may have interfered with the act of copulation. The promptness, however, with which conception was observed to take place even after the larger amounts of irradiation leads us to believe that the systemic and other influences did not play any rôle in producing sterility.

SUMMARY

1. One hundred and twenty-eight virgin adult albino rats received irradiation for the purpose of influencing ovarian function.

2. One hundred and nine of these irradiated animals lived to be mated on the fourteenth day following treatment, 19 animals dying before that day from the effects of irradiation.

3. Fifteen of the remaining animals died within 4 months of treatment and mating as result of the irradiation.

4. Ninety-four irradiated and mated animals lived for a period of 4 or more months. Forty-one per cent of these remained sterile.

5. Of the animals receiving less than 450 millicurie hours of irradiation over each ovary, only 14 per cent remained sterile; while exposures of 450 millicurie hours or more over each ovary resulted in permanent sterility in 74 per cent. Those animals which died within 4 months of mating time are not included in these two groups.

6. Of the animals which received 600 millicurie hours or 650 millicurie hours of irradiation and lived for at least 4 months following mating, 66 per cent were sterile. Six hundred and fifty millicurie hours applied to each ovary separately (a total of 1,300 millicurie hours) was the largest dose employed.

CONCLUSIONS

1. With the technique and amount of radium irradiation employed in the present study, it was found to be impossible to sterilize 100 per cent of the animals.

2. Radium exposure of the rats' ovaries, in amounts not quite large enough to kill the animals, will probably sterilize between 60 and 75 per cent of them.

The author is greatly indebted to Mr. Charles Robb, assistant physicist of the Philadelphia General Hospital, for his help in the preparation and measurement of the radium throughout the whole experiment.

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A RÉSUMÉ OF THE OSTEOCHONDRITIDES[1]

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STARTING with Muller in 1888, various writers have described a number of conditions which are now looked upon as being fundamentally similar processes with similar characteristics occurring at different growth periods. These conditions are collectively grouped under the term osteochondritis, which is taken to signify a non-inflammatory derangement of the normal process of bony growth occurring at the various ossification centers at the time of their greatest developmental activity.

Muller is credited with being the discoverer of epiphyseal coxa vara or displacement of the capital epiphysis of the femur. In 1903 Osgood and Schlatter independently described what is commonly known as Osgood-Schlatter's disease of the tibial tubercle. Koehler's disease of the tarsal scaphoid (16) was described in 1908. In 1910 Legg (18) and later in the same year, Calvé (6) and Perthes, independently noted an affection of the femoral head which is variously called Legg's disease, Perthes' disease, Calvé-Legg-Perthes' disease, osteochondritis deformans juvenilis coxæ, capital coxa vara, or coxa plana. In 1914 Freiberg described an infraction of the head of the second metatarsal bone, and Koehler (17) wrote in 1924 on the same condition which has since been known as Koehler's disease of the second metatarsal bone. Vertebral epiphysitis was described by Scheuermann in 1921, by Delahaye in 1924, and by the present writer (3, 4) in 1925. In 1925 Calvé (7) noted two cases of a peculiar affection of the vertebral body. Three cases were added by the author (5) in 1927 under the title: "Osteochondritis of the Vertebral Body." During the last decade similar conditions have been found to occur at practically every ossification center that is subject to stress and strain. Among these are included the sternal end of the clavicle (11), the acromion, the coracoid process of the scapula, the head of the humerus (20), the internal epicondyle of the humerus (19), the olecranon (25), the heads of the metacarpal bones (23), the iliac crests (3), the pubic bones (37), the ischial tuberosity (38), the greater and lesser tronchanters of the femur (25), the patella (14), the upper end of the tibia (30), lower ends of the tibia and fibula (35), the os calcis (34), the astragalus (26), the base of the fifth metatarsal, the heads of the metatarsal bones (10, 16, 24), and the sesamoids of the big toe (36).

That all of the separately described conditions are manifestations of a systemic affection is now generally agreed upon. Hartley states: "It is interesting to note that each lesion is associated with a definite age period and in each the age period is that in which the affected bone nucleus normally is actively developing." Christie is of the opinion that no epiphysis in the body is immune to the disease and that it is the same pathological entity modified only by the particular location. Clinically there are a number of cases on record in which a multiplicity of lesions was noted. I have seen a considerable number of instances in which more than one lesion existed. In one case that came under my observation there was an involvement of several of the vertebral bodies in the dorsal region, practically every superior and inferior vertebral epiphysis, the femoral heads, the greater and lesser tronchanters, the lower ends of the tibiæ, both astragali, and in the shoulder region the coracoid process and the acromion.

It will be impossible, in the space allotted me, to go into a detailed discussion of the various etiological theories that have been propounded and which were fully discussed in my previous communication. I will, therefore, limit myself to the additional data that has been accumulated on this phase of the subject. Suffice it to say that tuberculosis and syphilis have been definitely ruled out as etiological factors.

[1]Read before the Orthopedic Section, New York Academy of Medicine, March 15, 1929.

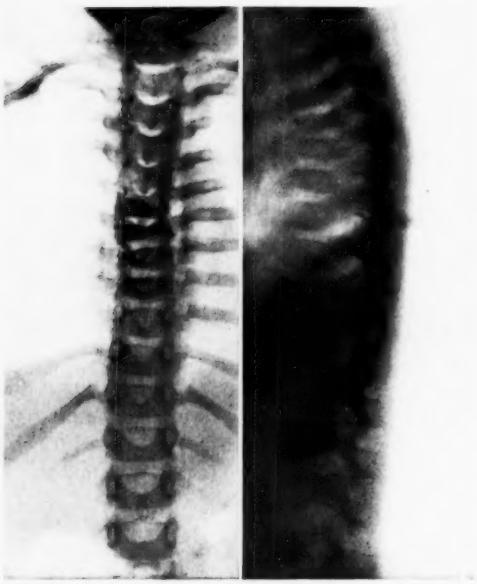

Fig. 1 (left). Case 1. Osteochondritis of the fifth, sixth, seventh, and eighth dorsal vertebral bodies. A 3 year old girl, fell three months previously a distance of 25 steps. Mother noticed poor posture. Physical examination shows a slight knuckle formation at the level of the sixth dorsal vertebra; no pain; no tenderness; no limitation of motion. X-ray shows a thinning of the vertical diameter of the bodies of the fifth, sixth, seventh, and eighth dorsal vertebræ and a widening of the intervertebral spaces.

Fig. 2. Case 1. Lateral view of patient shown in Figure 1. Note kyphos in mid-dorsal region, flattening and wedging of the fifth, sixth, seventh, and eighth dorsal segments. The seventh dorsal vertebra presents irregular outlines. The intervertebral spaces are comparatively wider than those in the unaffected areas.

A number of writers have suggested late rickets as a cause of this disturbance. In an unpublished study of over 50 cases of various forms of osteochondritis, I have found a normal phosphorous and calcium content of the blood serum. In 12 of these, the potassium, the magnesium, and the sodium content of the serum was normal. Clinically and roentgenographically there is no evidence whatsoever of rickets.

The theory of endocrine dyscrasia is purely an assumption, for the great majority of the cases do not present any evidence of endocrine dysfunction. The frequency of cervical coxa vara in those affected with Froehlich's syndrome is merely coincidental and is the result of the increased stress and strain caused by an increase in body weight on the femoral capital epiphysis, the attachment of which is weakened by physiological changes occurring at this time, namely: rapid growth, atrophy of the periosteum of the neck, and increasing obliquity of the epiphyseal line.

The infectious theory has only in its favor the observation that several surgeons have, at operation, obtained positive cultures. This, however, has been in the main discounted by the numerous sterile cultures and the absence of any evidence of inflammatory reaction on microscopic examination. None of these conditions have been known to suppurate.

Von Axhausen's theory of aseptic embolism, necrosis, and minute compression fractures resulting from slight traumata has been discounted by many writers. It seems inconceivable that these processes should always occur at given age periods in given locations. Just why embolism should occur in the spines of otherwise healthy individuals first during the first few years of life and then after a quiescent period recur during the second period of rapid growth, is difficult to explain by this hypothesis. Similarly, this theory does not account for bilateral lesions one sees in cervical and epiphyseal coxa vara, or in tibial apophysitis. Furthermore, the pathological changes are not wholly explainable on this basis. If it be granted that there is embolism in the terminal vessels of the capital epiphysis in Legg's disease, how can the concomitant pathological changes noted in the femoral neck be explained? It is rather far fetched to explain the widening of the femoral neck in the last mentioned condition on the basis of embolism, necrosis, and comminuted fractures.

Trauma plays an important part in the causation of these disturbances. Mau (21) has pointed out that rapidly growing bone cells are physiologically weak. If, at the time of rapid growth, a static imbalance occurs resulting either from an increased stress or strain or a decreased capacity to withstand stress or strain, a derangement of the normal process of growth occurs giving rise to compression fractures and irregularities in growth. Schmorl and Harrenstein have independently

Fig. 3.

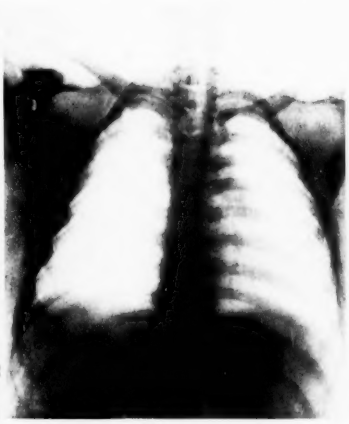

Fig. 4.

Fig. 5.

Fig. 3. Case 2. Osteochondritis of the superior and inferior vertebral epiphyses and bilateral epiphyseal coxa vara. Boy, age 15, Froehlich type—weight 170, height 5 feet, 7 in.—presents moderate limitation of abduction and extension of both hips. X-ray shows widening and mottling of the epiphyseal line; the femoral head in the early stages of slipping; the upper border of the neck is continuous with the head. The opposite hip presents the same picture.

Fig. 4. Case 2. Back negative clinically. Anteroposterior view of the spine shows narrowing of the intervertebral spaces in the dorsal region and irregularities of the vertebral outlines.

Fig. 5. Case 2. Lateral view of the spine showing wedging and moth eaten appearance of the bodies, lamination and fragmentation of the superior and inferior epiphyses, and mottling of the intervertebral spaces.

shown that an overload on the spine causes flattening of the intervertebral discs with tension on its fibrous walls. Because of its tension the cartilaginous cells of the intervertebral discs proliferate, break through, and grow into the epiphyseal cartilages and invade the vertebral bodies. When this occurs before growth is completed, the possibilities of deformed growth with resultant kyphosis and scoliosis become very likely. More recently, Mau (22) has succeeded in producing in the tails of white rats, by suturing them subcutaneously to the abdomen, a condition similar, in all respects, to the vertebral epiphysitis.

Though it must be admitted that the etiological and pathogenic conceptions of osteochondritis are still somewhat indefinite, yet one is forced to admit that trauma, in the form of increased stress and strain, is in all probability a very important factor. Clinically, the condition exists at all bony nuclei subject to stress and strain.

The pathology of osteochondritis is not very well established. As stated above, Schmorl and Harrenstein have found in vertebral epiphysitis that there is an invasion and proliferation of cartilage in the vertebral body and a breaking up of the epiphyseal cartilage. Key, in summarizing the pathology noted in

Fig. 6. Case 3. Osteochondritis of the superior and inferior vertebral epiphyses (vertebral epiphysitis). A 14 year old girl showing wedging and a moth eaten appearance of the vertebral bodies, thickening, irregularity, and fragmentation of the superior and inferior vertebral epiphyses.

Fig. 7. Case 4. Osteochondritis of the tarsal scaphoid (Koehler's disease). A 3½ year old boy complaining of pain and swelling over the scaphoid. Earlier X-rays negative. Present roentgenogram shows thinning, irregularity, and increased calcification of the scaphoid.

Fig. 9. Case 6. Osteochondritis of the femoral capital epiphysis (Legg's disease). A 4 year old girl complaining of a slight limp. Physical examination is practically negative save for a slight limp and a slight limitation of abduction and internal rotation. Roentgenogram shows an increased and cloudy joint space; a flattened, fragmented, thinned, and intensely calcified femoral head; a widening of the epiphyseal line; and a thickening, shortening, and mottling of the neck of the femur.

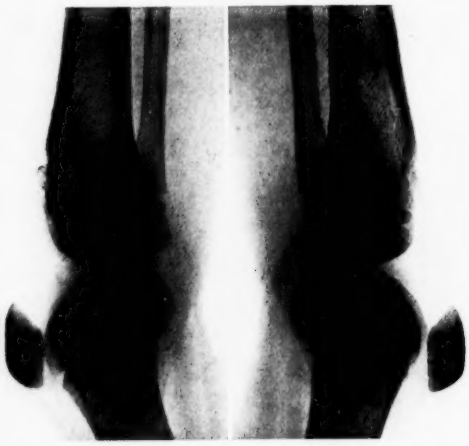

Fig. 8. Case 5. Bilateral osteochondritis of the tibial apophysis (Osgood-Schlatter's disease). A 12 year old boy complaining of pain and enlargement of the tibial tubercle. Roentgenogram shows rarefaction, mottling, irregularity, and fragmentation of the tibial tubercles.

cervical coxa vara, found that in the early and moderately advanced cases there were islands of cartilage just distal to the epiphyseal cartilage and that with an increased severity of the condition, as seen roentgenographically, there was an increase in hæmorrhagic and necrotic areas with fibrous replacement of bone and marrow. Similarly we find that Zemansky, in speaking of Legg's disease, found reports of islands of cartilage in the capital epiphysis in the early cases. Later, subchondral hæmorrhage, necrosis, destruction of the epiphyseal line, fragments of dead bone surrounded by vascular granulation tissue, and fibrous tissue replacement become the predominent characteristics.

Mau (22) has found in his experiments, with the tails of rats, that under the influence of abnormal pressure, changes occur in the endochondral ossification zone, the diaphysis, and most especially in the epiphysis. The epiphyseal cartilage reacts by an irregular widening of its cartilage proliferating zone. The diaphysis reacts by an increase of spongy, bony growth on the concave side and absorption and fibrous tissue formation rich in giant cells on the convex side. The epiphysis disappears on the concave side. In those epiphyseal areas in which the circulation is

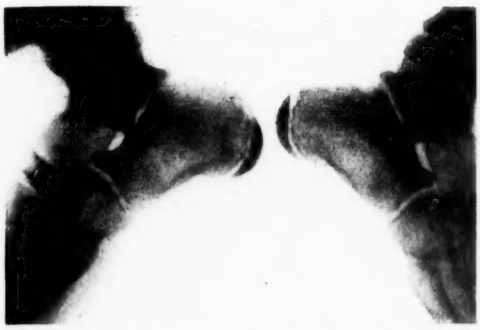

Fig. 10. Case 7. Osteochondritis of calcaneal apophysis. A 11½ year old boy complaining of pain and swelling of the left heel. Examination shows tenderness and swelling of the left heel posteriorly, while the right heel is negative. X-ray shows an intense calcification of the apophyses of both os calcis bones and waviness, widening, and irregularity of both epiphyseal lines.

sufficient, the reaction consists of a lamellar deposit of bone, while in those areas which have an insufficient circulation there is an absorption and even total necrosis of bone and marrow.

The pathology of the other forms of osteochondritis has not been sufficiently described for us to enter into discussion at this time. It is, however, to be noted that in those forms that have been described, there is a destruction of the epiphyseal cartilage and islands of cartilage are found in the already ossified areas. As the condition advances, hæmorrhage and necrosis—evidence of trauma—become more and more marked. Undoubtedly the variations described can be explained only by the various stages of the derangement and the superimposition of trauma. Amardi found in a case of Osgood-Schlatter's disease an irregular endochondral ossification and a formation of osteoid tissue.

Clinically, there is a very marked parallelism in the symptomatology of all of the various osteochondritides. As a rule, the patient is in good general health and is practically never acutely ill. All of the symptoms are mild. Occasionally these conditions are symptomless and are discovered only because of developing deformities. At times the affection may be bilateral and only one side may give symptoms. The clinical picture is almost always mild compared to the pathological picture as

Fig. 11. Case 8. Osteochondritis of the superior and inferior vertebral epiphyses (vertebral epiphysitis). A 17 year old boy complaining of pain in the back. Examination shows tenderness over the spinous processes of the lumbar vertebræ. Abdominal palpation causes pain in the region of the spine. X-ray shows moth eaten appearance of anterior portions of the first, second, third, and fourth lumbar vertebræ.

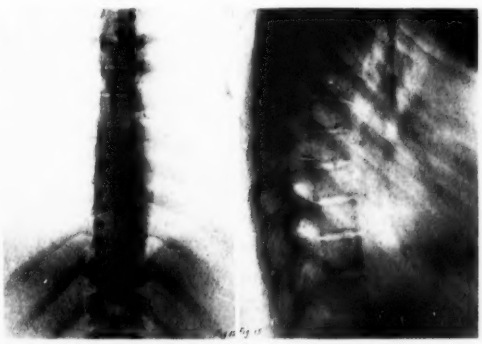

Fig. 12–13. Case 9. Osteochondritis of the superior and inferior vertebral epiphyses (vertebral epiphysitis). A 21 year old girl complaining of pain in the interscapular region for the past two and a half years. Examination shows a hollow round back. X-ray: The anteroposterior view shows haziness and indistinctness of the vertebral outlines and narrowing of the intervertebral spaces from the sixth down to the tenth dorsal vertebra. The oblique lateral view shows a moderately increa ed dorsal kyphos. The seventh dorsal vertebra is wedge shaped. The sixth and seventh dorsal bodies are eroded and the vertebral outlines are intensely calcified. The inferior epiphysis of the seventh dorsal body is thickened and irregular.

shown by the X-ray. The onset is usually gradual and there may, or may not be, a history of injury which, if present, is most commonly slight. The age of onset is parallel with the age of most active growth of the affected area. Involvements of the centrum of the vertebra occur in the first few years of life. When the superior and inferior vertebral epiphyses are affected, the age incidence is ten to twenty-one. Legg's disease occurs most commonly between the ages of 3 and 10, while the slipping of the femoral capital epiphysis occurs rarely before 10 years of age. Osgood-Schlatter's disease occurs at 13 to 15 years of age. Koehler's disease of the tarsal scaphoid occurs between 3 and 15 years of age. Apophysitis of the os calcis occurs between 9 and 13 years of age. Koehler's disease of the metatarsophalangeal joint occurs between 10 and 18 years of age.

The roentgenographic appearance of the various forms of osteochondritis is very similar. They all present a widening of the epiphyseal line. There are areas of rarefaction and condensation and the outlines are indistinct, giving the entire picture a hazy, mottled appearance. Following this, the bony areas become moth eaten and the outlines of the already ossified bony portion become irregular. When the reparative processes set in, there is condensation and reformation of the lamellar structures. The gross deformities, however, remain. The type of deformity produced varies with location of the lesion and the treatment instituted.

In view of our comparatively meager knowledge of etiological, pathogenic, and pathological factors involved, treatment must, per force, be symptomatic. All of these derangements are self limited and are terminated on completion of ossification. I doubt if, with our present knowledge, we can shorten the course of these affections. Our greatest hope is in the prevention of deformity. With early recognition of these conditions, pain whenever present can be alleviated, and deformity can practically always be prevented. To that end measures are instituted to rest the parts involved and to diminish all stress and strains on these parts. So that, as soon as the diagnosis is established, we must advise rest of the affected parts. This will relieve the discomfort. If deformity is present it should be corrected immediately. Treatment should be continued until ossification is complete.

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AUTO BLOOD TRANSFUSION IN GYNECOLOGY

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IN the literature of blood transfusion I have found several references to the replacement of blood, in a case of ruptured spleen, by British surgeons in India some fifty years ago. I have not been able to find the name of the surgeon or surgeons, and I do not know whether this measure was employed in more than one instance. It would seem probable that the conception of reinfusing blood lost by hæmorrhage was known in England at that time, for there is an article in the *London Lancet* in 1874 by Mr. William Highmore, F.R.C.S., senior surgeon to the Yeatman Hospital in Sherborne, suggesting that blood might be reinjected after hæmorrhage and saying that he had lost an obstetric case by hæmorrhage and that in a similar case he would collect the hæmorrhagic blood of the woman and "after it was defibrinated and warmed to the proper temperature by a clinical thermometer over a hot water bath he would inject it with a Higginson syringe and transfusion pipe." Kubanyi, of Budapest, says that the idea of auto blood transfusion originated with William Highmore. The practical application of this suggestion must have taken place not long after, for in the *Edinburgh Medical Journal* in 1885–1886, A. G. Miller, F.R.C.S., surgeon to the Royal Infirmary and lecturer on surgery in Edinburgh reports a "case of amputation at hip joint in which re-injection of blood was performed and rapid recovery took place." Two extremely interesting articles by Dr. Duncan on auto blood transfusion in amputations are in the British medical journals of 1885 and 1886. Dr. Duncan, in his first report, says that the importance of a few ounces of blood in cases of collapse can hardly be overestimated. He added 5 per cent of phosphate of soda, 1 part to 3 of blood, a method which he said was first used by Braxton Hicks on the recommendation of Dr. Pary. The second paper contains a word of caution not to "neglect stringent precautions needful to avoid the contingencies of septicity and embolism, lest it should fall into discredit from too wide an application." He adds: "I advocate it as perfectly sane and capable of saving many lives in the major operations of surgery. I make it a routine practise in all the larger amputations because there is no risk and every ounce of blood is serviceable . . . to my own mind the principle of re-infusing the patient is now definitely established." In spite of the favorable results obtained the "re-infusion" of blood seems not to have been widely practised in England as few references to it occur later.

The recent use of a patient's own blood for an infusion dates from 1914, when Johannes Thies, of Leipzig, re-injected the blood in three patients each one of whom had had a severe abdominal hæmorrhage following a ruptured tubal pregnancy, and each patient made a good recovery. Thies had previously examined bacteriologically several specimens of blood taken from the abdominal cavity in similar cases of hæmorrhage and had found the blood to be sterile and the red cells uninjured. In the first case salt solution was mixed with the blood in the proportion of 3:2 and the solution was given in the thigh. In the second case it was given in a vein in the arm and in the third case in a vein in the omentum. Thies reports these three cases in *Zentralblatt fuer Gynaekologie*, 1914, but was unable to continue as he was soon called to the front where he remained as assistant surgeon throughout the war. Auto blood transfusions were performed, however, in the Leipzig clinic by Lichtenstein, who reported in 1915 that eight more patients had had auto blood transfusions for hæmorrhage in ruptured tubal pregnancy with excellent result in each case. In 1918 and 1919 Lichtenstein described the technique, which he had now used successfully for 39 cases, and said that now "no woman operated upon because of tubal rupture ought to die from hæmorrhage without an auto blood transfusion." The method was now being used in several gynecological clinics in Germany with nearly universal approval. In

1920 Doederlein wrote enthusiastically of the result in 5 cases of his, giving to Thies the credit for the discovery of the method which he says is so strikingly simple and so wonderful in its results. Goder quotes Doederlein as saying that many certainly hopeless cases had been completely restored to life by auto blood transfusion. From this time on there were frequent reports in German literature of transfusing a patient with her own blood following an abdominal hæmorrhage from tubal pregnancy.

Writers differ, however, as to the term to use to describe this measure. In 50 reports 32 of the writers employ the words "auto blood transfusion," 9 use the term "auto blood infusion," and the other 9 call the practise a "reinfusion." This seems a needless confusion of terms. Webster defines the term transfusion as follows: "To pour out of one vessel into another." If to transfusion we apply the prefix auto blood (meaning a patient's own blood returned to his circulation after a hæmorrhage), we have a term that describes the transfusion and also differentiates it from the donor blood transfusion.

The first account that I have found of auto blood transfusion in this country was made by White,[1] November 29, 1920. The patient suffered from a ruptured liver and was given 500 cubic centimeters of his own blood (citrated). He made a good recovery. White used a Balfour aspirator to collect the blood and states that he had only two reactions in this and the five transfusions made subsequently.

Davis in 1922–1923 reports a case in which 600 cubic centimeters of his own blood was given in September, 1922, following a punctured wound of the spleen. The next report is in SURGERY, GYNECOLOGY AND OBSTETRICS in 1923 by Burch who made an auto blood transfusion in 1922 after removing a spleen. He states that he has used this measure successfully in 3 other cases—2 ruptured tubal pregnancies and 1 nephrectomy. Burch gives a bibliography and résumé of many of the early cases. He says that since 1914, 164 cases of auto blood transfusion have been reported in European literature but only 4 were reported from outside Germany. Two deaths occurred: one from a technical error, one from hæmoglobinuria. In conclusion Burch says that he believes that auto transfusion is a most valuable procedure in certain cases. This same year, also in SURGERY, GYNECOLOGY AND OBSTETRICS, Sir William Taylor, regius professor of surgery in the University of Dublin, describes on the editorial page of the September number his "Auto Infusion of Blood from the Spleen in Cases of Splenectomy," and Dr. William J. Mayo in another editorial that month, in writing of a visit to Dublin, says that Sir William immediately transfuses to the patient the free blood in the spleen. The next report of the use of a patient's own blood for transfusion is the extremely interesting account by Dr. Harvey Cushing at the Peter Bent Brigham Hospital and Dr. Loyal Davis, formerly Fellow of the National Research Council. Out of 285 major neurological operations in the clinic, blood replacement was carried out 23 times. Briefly stated, the blood was collected by a water suction apparatus, filtered through gauze, and then allowed to flow by gravitation into the basilic vein in the arm. In commenting the writers say: "There can be no question, however, but that the proportion of these admittedly formidable operations which have required more than one stage for their completion has been considerably cut down by the judicious use of this procedure. . . . It is a source of comfort to a surgeon, in the emergencies which may arise from an undue lowering of pressures, to know that there is ready at hand an infusion fluid which is fairly rich in the more essential blood elements . . . . a fluid which requires no grouping."

The technique now to be described of collecting a patient's own blood lost during an operation and later returning it to her veins was developed with the idea of salvaging the large amount of fluid blood found in the abdomen at the time of an operation for a ruptured tubal pregnancy. It has always seemed illogical to throw away a patient's blood and then institute a frantic search for a donor to supply blood, for even though the blood is of the same type and is compatible, still we know that a severe reaction sometimes follows. A distinguished pathologist of this city exclaimed

[1] Surg., Gynec. & Obst., 1923, xxxvi, 343

Sterile graduated collecting bottle containing sodium citrate solution
To Motor
Patient
Suction tube in abdominal cavity
Mug for collecting blood in severe intra-abdominal hemorrhage
Poole Suction Apparatus

Fig. 1.

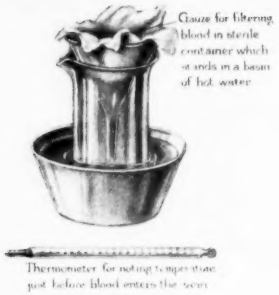
Gauze for filtering blood in sterile container which stands in a basin of hot water
Thermometer for noting temperature just before blood enters the veins

Fig. 2.

"That is not surgery" when he saw an operator throw away the specimen he had just removed from an abdomen. Perhaps we may say to throw away good blood is not surgery. It seemed that if we had a way to collect and return the blood quickly to the patient's veins that we might not need to make the more difficult blood transfusion and so avoid a reaction that is more apt to follow the injection of a donor's blood than the patient's own blood. The work of Levine and Segall at the Royal Victoria Hospital in Montreal has proved that, owing to the changes produced in the blood by the anæsthetic, reactions more often occur after a blood transfusion given in the first 24 hours following an operation.

For a year I kept in the operating room sealed sterile ampoules of 2 per cent sodium citrate solution ready for an auto blood transfusion in ruptured tubal pregnancy, but the frequent change of personnel in the interne and nursing staffs made it impossible to secure all the help needed for the transfusion, when the operation itself demanded my entire attention. I concluded that team work could be attained only by frequent practice of the technique on the simpler cases and arranged to try this measure in clean hysterectomies for myoma uteri. It was a surprise to me to find the transfusion so valuable. I had decided that the suction method we use to collect fluids from the abdomen was the best way to collect the blood flowing into the pelvis as the ladle or cup which is used for large amounts of blood would be in the way here and sponges should never be used as the squeezing out of the blood injures the red cells. Ten cubic centimeters of sterile 2 per cent sodium citrate solution was placed in the sterile graduated suction bottle and blood drawn to the 100 cubic centimeter mark. (This is the amount, 2 per cent, used by Lichtenstein who has shown by experiment that 5 grains of sodium citrate may be given safely to a patient; even though one returned 1000 cubic centimeters of blood to a patient the amount of a 2 per cent solution would be only 2 grains.) The bottle was then removed and a similar bottle containing the same amount of sterile sodium citrate solution was connected and suction begun again. The 100 cubic centimeters of citrate blood was then poured through 20 thicknesses of gauze wet with sterile normal salt solution. The gauze lay on the top of a sterile funnel which was in a sterile flask standing in a bowl of hot water. Five times as much sterile normal salt solution (105 degrees F.) as sodium citrate solution (i.e., 50 cubic centimeters) was poured over the blood which was then covered to prevent aeration and allowed to filter. Care was taken not to stir nor shake the blood to avoid injury to the red cells. The blood thus collected was then given by gravity method into the median basilic vein in the arm. (In cases of shock if the veins in the arm are collapsed the blood may be given with a syringe into a vein in the omentum or into the deep epigastric vein in the abdominal wall.) I did not know, until I had given blood to several pa-

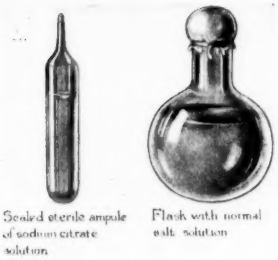

Fig. 3.

tients by this method, that Dr. Harvey Cushing had collected blood by suction and given it by this same gravity method. In the first cases transfused a specimen of the blood collected by suction was sent at once to the pathologist, who reported in each instance that the erythrocytes had not been injured by the suction method of collecting the blood. The first ten consecutive cases will be reported in the order in which they were operated upon. Auto blood transfusion was planned only for clean cases that had very large myomata uteri and when a difficult operation was anticipated either because of the size or the location of the tumor, or some condition of the patient, such as obesity or anæmia. Gum glucose solution was given in nearly every case as has been my practise for several years, when it was especially desirable to maintain blood pressure, as in a poor risk patient or in a long operation. Two hundred and fifty to three hundred cubic centimeters of the solution was usually given, and the blood pressure readings were taken just before the patient left the operating room and after the blood had been injected into a vein. As it happened the first case needed the blood transfusion more than I had anticipated.

CASE 1. Mrs. R., No. 42,017. Operation November 23, 1928, for a large blood cyst. Numerous coils of intestine were firmly adherent over the tumor. Two hundred fifty cubic centimeters of blood was collected in 25 cubic centimeters of 2 per cent sodium citrate solution and 125 cubic centimeters of normal salt solution were added. The patient left the operating room with blood pressure 124—70; pulse, 96; respiration, 36. There was no reaction of any kind and the convalescence was absolutely normal. It was a great comfort to know while operating that the blood would be replaced at once, and this permitted

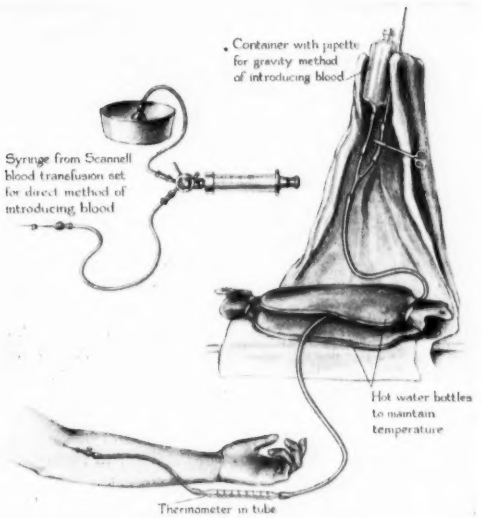
Container with papette for gravity method of introducing blood
Syringe from Scannell blood transfusion set for direct method of introducing blood
Hot water bottles to maintain temperature
Thermometer in tube

Fig. 4.

slower, more careful dissection of the intestines from the tumor than would have been justifiable if blood had not been available.

CASE 2. Mrs. W., No. 42,110. Operation December 10, 1928, hysterectomy for myoma uteri the size of a 3½ months' pregnancy. As the clotting time was 7 minutes, 45 seconds, it seemed that an auto blood transfusion might be of help. But the bleeding was slight and only 25 cubic centimeters of blood were collected. This was given together with 50 cubic centimeters of sodium citrate solution. This excess amount of sodium citrate was given by an assistant through a misunderstanding of the technique. The patient left the operating room with blood pressure 122—68; pulse, 88; respiration, 28. One hour after returning to her room the patient had a slight general tremor and dusky color, due, I believe, to the excess of sodium citrate solution. A hypodermoclysis of 1,000 cubic centimeters of normal salt solution was at once given. The tremor had subsided before the needles were introduced and the color promptly returned to normal in a few minutes. This was the only case that had any reaction whatsoever following auto blood transfusion.

CASE 3. Mrs. M., No. 40,643. Operation January 15, 1929, hysterectomy for vascular myomata uteri size of 5 months' pregnancy. This patient had been transfused several days before the operation because of a secondary anæmia and, as often happens after a recent transfusion, she bled freely. Two hundred cubic centimeters of blood was collected in 20 cubic centimeters of sodium citrate solution and 100 normal salt solution was added. The patient left the operating room with blood pressure 132—68; pulse, 96; respiration, 28. The blood count is of interest as

it shows no secondary fall in the number of erythrocytes but an appreciable gain a few days after the auto blood transfusion, which is contrary to the usual drop seen after donor's blood has been given. The pre-operative count taken January 12, 1929 (3 days before operation) was 4,500,000 red cells and 76 per cent hæmoglobin; January 16, 1929 (1 day postoperative), 3,550,000, 74 per cent hæmoglobin; January 21, 1929 (6 days postoperative), 4,000,000, 72 per cent hæmoglobin.

CASE 4. Mrs. R., No. 42,255. Patient 46 years old, frail type, hæmoglobin 40 per cent on entrance to the hospital (after blood transfusions, 82 per cent). Operation January 21, 1929, hysterectomy for myomata uteri extending 3 inches above the umbilicus. One hundred seventy-five cubic centimeters of blood was collected in 20 cubic centimeters of sodium citrate solution and with 100 cubic centimeters normal salt solution was transfused. The patient left the operating room with blood pressure 150—72; pulse, 100; respiration, 28. The convalescence in this case was remarkably smooth for such a frail patient and showed not only a maintenance of the blood but some increase 4 days after operation. The blood count was as follows: January 17, 1929 (4 days before operation), 4,450,000 red cells, 82 per cent hæmoglobin; January 25, 1929 (4 days postoperative), 4,460,000, 80 per cent hæmoglobin.

CASE 5. Mrs. B., No. 42,320. This patient was 50 years old and had a large myoma above the umbilicus, a cystocele and rectocele. As the plastic operation as well as the hysterectomy was necessary it was thought best to save as much blood as possible. The hysterectomy proved to be a simple one, however, and only 30 cubic centimeters of blood was collected in 10 cubic centimeters sodium citrate and saline, 150 cubic centimeters, was added. The blood pressure after operation was 110—76; pulse, 98; respiration, 38.

CASE 6. Mrs. M., No. 33,476. Operation February 28, 1929, hysterectomy for an extremely vascular myoma the size of a 5 months' pregnancy. One hundred seventy-five cubic centimeters of blood was collected in 20 cubic centimeters of sodium citrate solution and 100 cubic centimeters of normal salt solution. The patient left the operating room with blood pressure of 128—72; pulse, 120; respiration, 28. There was absolutely no reaction and convalescence was smooth except for a mild pyelitis which the patient had had a year previous to the operation. The blood count was as follows: February 27, 1929 (the day before operation) 4,840,000 red cells; hæmoglobin, 88 per cent March 6, 1929 (7 days after operation), 4,480,000 red cells, hæmoglobin 85 per cent.

CASE 7. Mrs. R., No. 42,517. This patient was 47 years old. Hæmoglobin was 43 per cent as a result of repeated hæmorrhages. She was transfused twice before operation. Operation February 2, 1929, hysterectomy for hyperæmic myomata extending above the umbilicus and into both broad ligaments. The rectum and sigmoid were densely adherent posteriorly and the bladder high on the anterior wall. It was necessary to split the capsule and shell the tumor out. The abdominal wall was unusually fat. The difficulties of this operation and the vascularity of the tumor made the auto blood transfusion of real value. Two hundred seventy-five cubic centimeters of blood was collected, to which was added 30 cubic centimeters of sodium citrate solution and 200 cubic centimeters of normal salt solution. The patient left the operating room with blood pressure 150—88; pulse, 94; respiration, 38. The blood count was as follows: January 28, 1929 (5 days before operation), 4,200,000 red cells, 70 per cent hæmoglobin; February 7, 1929 (5 days after operation), 4,150,000, 65 per cent hæmoglobin.

CASE 8. Mrs. K., No. 42,852. Operation March 28, 1929, hysterectomy for myoma. The rectum was densely adherent to the tumor. A hæmorrhagic cyst the size of an orange was found in the broad ligament. One hundred twenty cubic centimeters of blood was collected to which was added 20 cubic centimeters of 2 per cent sodium citrate and saline 200 cubic centimeters. Postoperative blood pressure was 135—25. March 25, 1929, 4,050,000 red cells, 72 per cent hæmoglobin (3 days before operation). March 30, 1929, 3,580,000 red cells, 70 per cent hæmoglobin (2 days after operation).

CASE 9. Mrs. Y., No. 42,682. Operation March 15, 1929, hysterectomy for myomata uteri the size of a 4 months' pregnancy with left broad ligament myoma the size of a golf ball. One hundred thirty-five cubic centimeters of blood was collected in 15 cubic centimeters of 2 per cent sodium citrate solution and 140 cubic centimeters normal salt solution was added. Patient left the operating room with a blood pressure 122—86. The blood count was as follows: March 11, 1929, 4,850,000 red cells, 85 per cent hæmoglobin (4 days before operation); March 16, 1929, 4,200,000 red cells, 80 per cent hæmoglobin (1 day after operation); March 18, 1929, 3,590,000 red cells, 75 per cent hæmoglobin; March 20, 1929, 3,890,000 red cells, 75 per cent hæmoglobin.

CASE 10. Mrs. C., No. 42,740. Operation March 26, 1929, hysterectomy for myoma the size of a 4 months' pregnancy, with a myoma filling Douglas' cul-de-sac and a parovarian cyst the size of a grapefruit. There was very little bleeding and only 15 cubic centimeters of blood was collected, to which was added 10 cubic centimeters of 2 per cent sodium citrate, 100 cubic centimeters saline. Blood pressure 144—96. Blood count March 18, 1929, 4,200,000 red cells, 82 per cent hæmoglobin.

Of these first 10 cases to whom auto blood transfusion was given because of anticipated bleeding, 3 lost only a negligible amount of blood—15 to 30 cubic centimeters—4 lost from 120 cubic centimeters to 175 cubic centimeters, and 3 lost from 200 cubic centimeters to 275 cubic centimeters. It is not in the least likely that any one of the patients would have

died without this transfusion but for Cases 1 and 3 I might have ordered a donor blood transfusion and I certainly would have for Case 7. The convalescence was so smooth for every patient it was a pleasure to see the result. It is of interest to note that 3 patients receiving 175 to 275 cubic centimeters of blood had no secondary fall in red cells as commonly occurs after a donor blood transfusion. The first and sixth patients unfortunately did not have a count made early enough to show whether this would have been so or not.

CASE 11. Mrs. P., No. 42,768. Reported through the kindness of Dr. Ward. This was a diabetic patient with a mild anæmia, who had a fibroid extending to the umbilicus and pressure symptoms necessitating its removal. Operation March 22, 1929, hysterectomy. One hundred forty cubic centimeters of blood was collected and 20 cubic centimeters 2 per cent sodium citrate and 300 cubic centimeters normal saline were added. The patient was in such an absolutely satisfactory condition at the end of operation that the donor blood transfusion, which had been ordered, was deferred until 24 hours later, to avoid a possible reaction due to changes in the blood produced by the anæsthetic. The blood count was as follows: March 19, 1929, 3,850,000 red cells, 65 per cent hæmoglobin; March 23, 1929, blood transfusion, 500 cubic centimeters, donor blood; March 25, 1929, 4,600,000 red cells, 86 per cent hæmoglobin.

CASE 12. Mrs. K., No. 42,694. I am reporting this case with the kind permission of the surgeon who is on the courtesy staff of the hospital. The patient was taken to the operating room because of a secondary hæmorrhage. It was impossible to get the blood pressure when she arrived there. "The abdomen was tensely distended with large amount of fluid blood and clots. The fluid blood (400 cubic centimeters) was aspirated from the abdomen, citrated, filtered, and mixed with gum glucose solution and preparation made for infusion into a vein in the arm. As the patient's veins were completely collapsed it was necessary to cut down on the vein before the needle could be introduced. The bleeding point was clamped and at the same moment the patient ceased breathing and was pulseless. Adrenalin was immediately administered and artificial respiration begun; by this time the infusion started, and as the infusion solution entered the circulation the pulse promptly responded. The wound was closed and on the arrival of the donor 500 cubic centimeters of blood was given to the patient in the other arm." She left the operating room with a blood pressure of 126—70 and made an excellent convalescence. Four hundred cubic centimeters auto blood was transfused together with 225 cubic centimeters gum glucose solution. The blood count was as follows: March 11, 1929, (1 day before the first operation) 4,650,000 red cells, 85 per cent hæmoglobin; March 13, 1929, after 400 cubic centimeters auto blood transfusion, 500 cubic centimeters donor blood transfusion, 4,000,000 red cells, 70 per cent hæmoglobin.

The surgeon told me "There was absolutely no pulsation in the abdomen when the infusion started" and that he believed "the patient never would have recovered without the gum glucose solution and auto blood transfusion." The technique could not have been carried out in such a grave emergency if the staff had not been trained to team work in the simpler cases. One such patient saved would be well worth the time and effort spent to train the interne and nursing staff.

Very little equipment is needed. Every operating room should have a suction apparatus to collect fluid. It need not be an expensive electric driven motor, as tubing connected to a double faucet produces sufficient suction by means of running water. Sealed sterile ampoules of 2 per cent sodium citrate solution are not expensive and keep indefinitely. *Team work is essential.* It is necessary not only to explain the technique to the staff but they must practise it often enough on simpler cases so that in an emergency operation they are competent to make the transfusion without instruction from the operator. The order "auto blood transfusion" ought to mean the suction tube in the abdomen and citrate solution in the graduated bottle ready to begin suction 2 minutes after the order is given. An auto blood transfusion does not interfere in the least with the operation. The sterile suture nurse changes the bottles and filters the citrated blood. The second assistant manages the suction tube and can drop out at the end of the operation and inject the blood, or a third assistant can give the blood during the operation if desired. If he has been giving gum glucose solution the blood is simply poured into this. In teaching the staff one should caution them.

1. Never use stagnant or clotted blood or blood if there is any suspicion of infection in the pelvis or abdomen.

2. Ten cubic centimeters of a sterile 2 per cent sodium citrate solution should be used with each 90 cubic centimeters of blood to prevent coagulation, and 5 times as much

sterile normal salt solution should be used as sodium citrate solution—more salt solution may be added if desired to offset the loss of body fluids.

The advantages of an auto blood transfusion are:

1. It lessens or prevents shock by supplying immediately blood to the circulation at a time when every ounce of blood counts.

2. It obviates the delay necessary to find a donor and type and match the blood.

3. It supplies a compatible blood and thus avoids a reaction due to the incompatibility of the donor's blood with the recipient resulting from changes in the recipient's blood produced by the anæsthetic.

4. The ease and simplicity of this method makes it possible to give it to patients for whom one would hesitate to order a donor blood transfusion.

CONCLUSIONS

1. Auto blood transfusion may be a valuable aid in difficult clean pelvic operations associated with hæmorrhage.

2. Auto blood transfusion may be a life saving measure in emergencies if the interne and nursing staff are thoroughly trained to carry out this technique in the simpler cases.

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BILE LEAKAGE FROM THE CYSTIC DUCT FOLLOWING CHOLECYSTECTOMY

An Experimental Study of the Obliteration of the Cystic Duct Stump[1]

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A MOOT subject in gall-bladder surgery which has attracted much comment is the matter of drainage after cholecystectomy. Many surgeons insist upon routine drainage while others not only do not drain but consider the act unnecessary and possibly harmful. Between these extremes must lie a meridian of scientific accuracy which might be determined if we knew what reparative or retrogressive changes take place in the structures involved in the operation.

An analysis would indicate that there can be three possible reasons for drainage: infection, hæmorrhage, and bile leakage. Most surgeons, I believe, are agreed that when an acute infection is encountered, such as gangrene with local peritonitis, drainage is not only safe but desirable. In those cases in which oozing from the liver bed cannot be controlled with compression, fat packs, or ligation, a gauze compact for 24 to 48 hours is necessary. These two conditions rarely cause adverse comment. In bile leakage we find the basis for most of the conflicting opinions. Viayazo (4) endeavored to prove that any opening in the gall bladder or ducts would very soon become occluded by omentum or other neighboring structures and that in the experimental animal, death due to bile leakage was never encountered. In some later experiments (5) his opinion was materially changed. Richter, from clinical experience only, disproves of drainage on the assumption that bile is not toxic and will do little harm if allowed to flow into the peritoneal cavity. This is disproved by the studies of Horrall and Still who have shown, it seems without doubt, that bile, especially the choleic salts, are intensely toxic and that 5 cubic centimeters of bile per kilogram of body weight if injected into the peritoneal cavity of the dog will cause death quite promptly.

Clinical histories indicate that not infrequently after a cholecystectomy bile appears in varying quantities in the upper abdominal cavity. A careful investigation would lead one to believe that the bile may find its way into the peritoneal cavity in several ways. In the delivery of the liver, tears of the liver parenchyma may involve small biliary ducts and subsequently there may be a moderate amount of bile leakage. The amount will depend upon the number and size of the ducts injured and the possibility of rapid repair. Occasionally, small accessory ducts may lead directly from the liver substance or the hepatic duct into the gall bladder, thus there may be leakage from the gall-bladder bed. I have seen several instances in which fair sized ducts entered the fundus of the gall bladder near its tip. These discharged sufficient bile to be noticed at the time of the operation and were ligated. Injury to the major ducts, either common or hepatic, may lead to secondary or delayed biliary drainage. Most diversities of opinion seem to evolve about the possibility of cystic duct leakage.

On the assumption that the ligature may slip off, cut through, or for sundry other reasons, a number of procedures have been advocated for special ligation of the cystic duct. In searching the literature only one reference could be found which pertained to the repair or change in the cystic duct after cholecystectomy. Hofmann described an obliterating process in the cystic duct which is different from that found in blood vessels after ligation, but his statements were not verified by animal experiments or studies of human specimens.

It occurred to me that a carefully planned experimental study of the changes in the cystic duct after cholecystectomy in the dog might answer the question of bile leakage, at least so far as the cystic duct is concerned.

[1]From the Laboratory of Surgical Research, Northwestern University, Chicago. Preliminary report read before the Chicago Surgical Society, December 7, 1928.

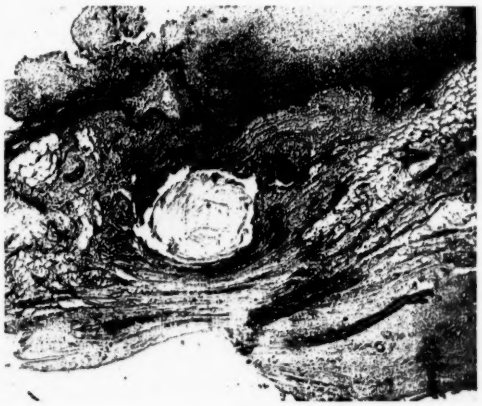

Fig. 1. Low power photomicrograph showing cross-section of ligature surrounded by the exudate. The constricted area of the duct lies below the ligature. The area to the right is the proximal portion of the duct. (Day 1.)

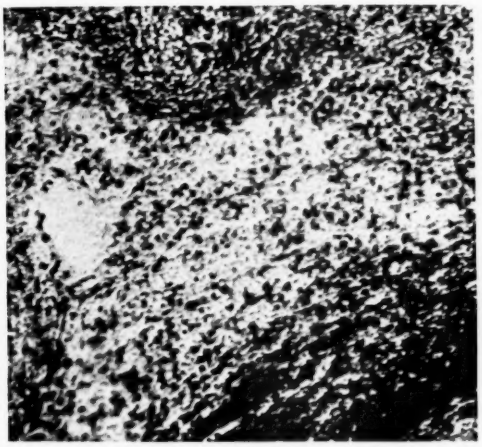

Fig. 2. Photomicrograph showing the nature of the exudate. In the center many red blood cells can be seen, the darker areas are essentially leucocytes. 245 diameters. (Day 1.)

A series of 46 dogs were subjected to cholecystectomy. All animals received preoperatively morphine and atrophine and were operated upon under ether anæsthesia, strict aseptic technique being used. In the earlier experiments catgut was used for the duct ligature, later silk was employed because, in the process of formalin or Zenker fixation of the duct specimen, the catgut became so hard that when sections were cut the hardened gut would tear through the section before it was completely cut by the microtome knife; thus many valuable sections were destroyed. Moreover, in the late specimens, 15 to 33 days, the area of ligation was often uncertain because of the disappearance of the gut. The cystic artery in most instances was ligated well proximal to the site of the duct ligation.

It is well to call attention to certain anatomical differences in the biliary passages of the dog and man. These differences, I believe, are important so far as the process of repair is concerned. In the dog the cystic duct is almost completely surrounded and closely enveloped by the tough fibrous serosa and in doing a cholecystectomy it is unnecessary, in fact, impossible, to separate this coat from the muscular wall. In man the cystic duct lies between the folds of the duodenohepatic ligament, and in doing a cholecystectomy the margins of the ligament are divided and the duct is separated from its peritoneal investment before ligation. In the dog the cystic artery lies anterior and usually just above the cystic duct and sends small branches to the duct through the peritoneal investment. It can often be ligated with little disturbance in anatomical structures. In man, as is well known, the artery can be found only after rather tedious and liberal dissection of the border of the duodenohepatic ligament and in most instances is found passing at an angle

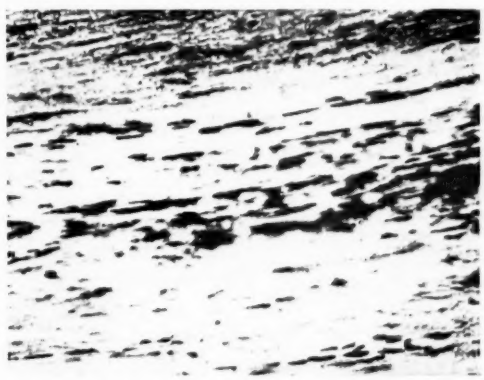

Fig. 3. Photomicrograph taken of the zone within the grasp of the ligature showing the elongation and compression of the nuclei. 275 diameters. (Day 1.)

Fig. 4. Low power photomicrograph through the zone of ligation. The area to the right is the proximal side of the duct. This demonstrates the disappearance of the mucous membrane beneath and distal to the ligature also the loss of normal structure in the distal portion of the duct. (Day 2.)

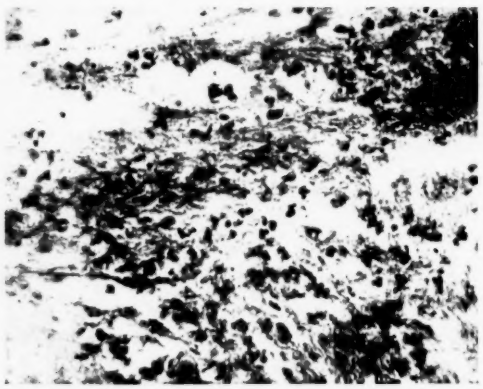

Fig. 5. Photomicrograph showing necrosis with leucocytic and red blood cell infiltration in that portion of the duct distal to the ligature. 275 diameters. (Day 2.)

downward, anteriorly, and to the left to lie behind or to the right of the cystic duct and gall-bladder neck.

Specimens of the ligated cystic duct of the experimental animal after cholecystectomy were studied at intervals from 1 to 33 days. In some instances portions of the adjacent liver were removed with the adherent duct *in situ*, and the whole was fixed and serial sections were cut. There was some variation in both gross and microscopic findings at the various periods. An explanation for these differences will be offered later.

Fig. 6. Low power photomicrograph at the zone of ligation. This demonstrates the necrosis beneath and distal to the ligature, also the definite zone of necrosis proximal to the ligature. The area to the right is the proximal portion of the duct. (Day 3.)

DAY 1. The stump of the duct was uniformly buried by the lobes of the liver. Upon separation of the liver lobes the duct was found adherent to the liver structure and an exudate of variable amount covered the interstices about the duct, especially the ligature (Fig. 1). One animal, No. 68, died at the end of 24 hours and at autopsy the peritoneal cavity was found filled with a bile stained fluid and a perforation was found just proximal to the ligature. This perforation as no doubt produced by an attempt to strip the serosa from the duct at the time the cholecystectomy was performed. This was done in an effort to study, if possible, the repair of the duct deprived of its peritoneal coat.

Microscopical findings. The exudate was a homogeneous mass consisting of red blood cells, coagulated lymph, and serum rich in leucocytes (Fig. 2). This mass was closely adherent to the duct and invariably buried the ligature and surrounding duct tissues. It stripped easily from the duct. *Duct.* Under the ligature the cells were compressed and the nuclei were elongated (Fig. 3). Distal to the ligature the cells were degenerating, the nuclei were less distinct, and there was extensive red blood cell and leucocytic infiltration. Proximal to the ligature for a short distance fewer nuclei were to be seen with also extensive red blood cell and leucocytic infiltration.

DAY 2. The exudate was a trifle more brittle than on the previous day and still stripped readily from the duct; otherwise the gross findings were essentially the same as on the preceding day.

Microscopical findings:. The exudate contained considerable cell débris with many red blood cells

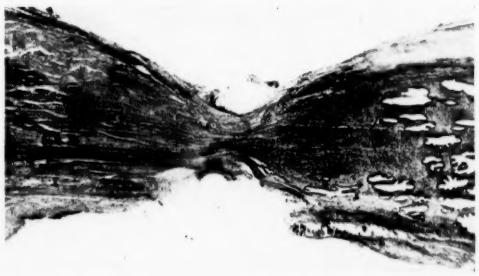

Fig. 7. Low power photomicrograph at the zone of ligation. This again shows the zone of proximal necrosis. (Day 4.)

and polymorphonuclear leucocytes. *Duct.* Under the ligature the nuclei although thinned and elongated still stained fairly well. In a number of specimens there was beginning leucocytic infiltration of this zone. Distal to the ligature there was diffuse and very extensive leucocytic infiltration with many red blood cells present. The mucous membrane was beginning to disappear and the nuclei of the fixed cells stained less clearly (Figs. 4 and 5). Proximal to the ligature was extensive red blood cell and leucocytic infiltration and for several millimeters the nuclei of the fixed cells stained less definitely. The mucous membrane in this area had also disappeared.

Day 3. The exudate was more firm and adherent both to the duct and adjacent liver tissue although the duct still shelled out quite readily.

Microscopical findings. The exudate consisted of much cell débris and leucocytes and embryonic connective cells were appearing at the zone of contact with the duct wall and liver edge. *Duct.* Under the ligature the nuclei still took the stain and there was some leucocytic infiltration. In some areas the cells were fragmented and the nuclei had disappeared. Distal to the ligature in some specimens there was almost complete necrosis of the duct wall with extensive leucocytic infiltration (Fig. 6). In other specimens there was less necrosis and there still remained many viable cells, the nuclei of which stained fairly well. Proximal to the ligature for several millimeters, many specimens showed necrosis with leucocytic infiltration. The distance the proximal necrosis extended varied in different specimens. The leucocytic infiltration extended well beyond the zone of necrosis.

Day 4. The gross appearance was not unlike that of the previous day.

Microscopical findings. The exudate was essentially like that of the third day with perhaps more young connective tissue cells present. *Duct.* In some specimens the distal part of the duct contained many viable mature cells with islets of mucous membrane intact. Invariably there was extensive leucocytic infiltration. In other specimens there was almost complete necrosis with leucocytic infiltration.

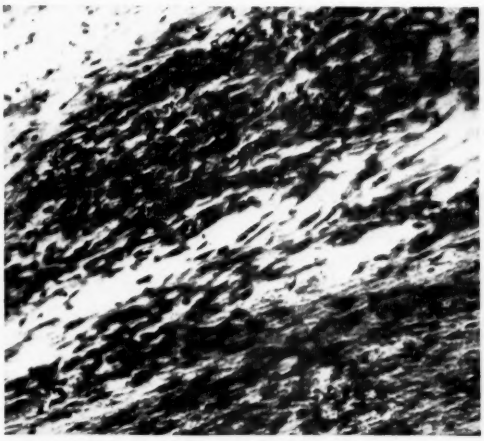

Fig. 8. Photomicrograph demonstrating leucocytic infiltration and necrosis proximal to the ligature. 250 diameters. (Day 4.)

Necrosis proximal to the ligature was uniformly present (Figs. 7 and 8).

Day 5. The exudate was rather brittle and clung more closely to the duct and liver tissue. The duct at the site of ligation was very friable and would break asunder with the slightest trauma. In animals No. 59 and 61 the duct broke off at the site of ligation even though great caution was exercised in its removal.

Microscopical findings. The exudate adhered rather closely to the duct wall and contained many young connective tissue cells. These cells for the most part lay in the zone of exudate which was adjacent to the duct wall or liver tissue. *Duct.* Viable cells were still found under the ligature in some of the specimens and here and there a young connective tissue cell would be seen but for the most part the structures within the grasp of the ligature were not viable and consisted essentially of collagen fibers. In a number of sections the structures under and about the ligature were fragmented (Figs. 9 and 10). Those specimens which broke asunder in their removal showed necrosis with red blood cell and leucocytic infiltration. The distal portion of the duct showed areas of necrosis and other areas where the cells were viable. There was also evidence of beginning fibrosis. The area just proximal to the ligature appeared homogeneous with leucocytic infiltration. Some fragmentation was also present (Fig. 11).

Day 6. The structures were well sealed over and the gross findings were not unlike those of the fifth day. The tendency to separation at the point of ligation was also present.

Microscopical findings. The exudate clung closely to the duct wall and often could not be differentiated from the duct (Fig. 12). *Duct.* In one specimen

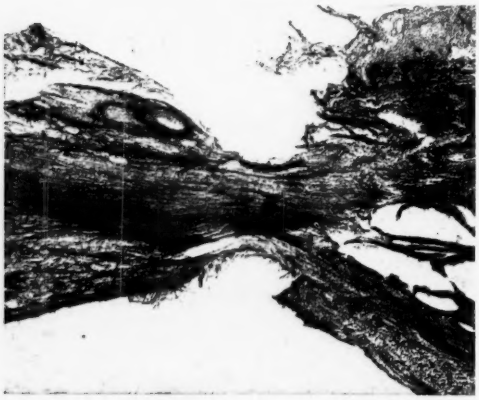

Fig. 9. Low power photomicrograph of the zone of ligation. This demonstrates the necrosis beneath and distal to the ligature. It also shows the tendency to fragmentation proximal to the ligature. (Day 5.)

there was extensive cellular invasion of the area within the grasp of the ligature (Fig. 13). The cells were leucocytes and a few young connective tissue cells. Other findings were essentially as those of the fifth day. In a ruptured specimen, No. 58, the zone of separation contained quite a few young connective tissue cells and leucocytes with red blood cells. Few adult nuclei could be found.

DAY 7. The gross appearance was but little different from that of the several previous days but there was less tendency to break at the point of ligation. The distal portion of the duct showed evidence of fibrosis with extensive necrosis in most instances. This necrosis extended well proximal to the ligature and no evidence of repair could be seen at the site of ligation (Fig. 14). The necrotic

Fig. 11. Photomicrograph showing the fragmentation proximal to the ligature. 175 diameters. (Day 5.)

Fig. 10. Photomicrograph showing the disappearance of the nuclei beneath the ligature. 275 diameters. (Day 5.)

areas showed extensive leucocytic infiltration. The exudate was rich in young connective tissue cells, which could be seen in large numbers adjacent to the duct wall and liver (Fig. 15). These cells seemed more mature in nature than on previous days.

DAY 9. There was little change from conditions as described on the seventh day. In the preparation in which the duct was loosely ligated and leaked with increase of pressure, the mucous membrane remained intact under the ligature but the muscular wall had disappeared (Fig. 16). This specimen also showed less distal necrosis.

DAY 10. The duct was imbedded in organizing exudate. The exudate contained large numbers of connective tissue cells with less leucocytes, and blood channels were forming. The distal end of the duct was undergoing fibrosis. The tissues in the grasp of the ligature were in part fragmented, at times being invaded by young connective tissue cells (Figs. 17 and 18).

DAYS 11 to 20. These specimens showed some daily variation but essentially the process was that of organization of the exudate and fibrosis of the duct stump (Fig. 19). In many sections extensive necrosis was present. The rate at which the organization or cellular maturation of the exudate took place was variable. In some specimens it was well under way at 11 to 14 days, in others it appeared to be delayed. Distal to the ligature at 20 days, areas of necrosis which contained few viable cells except possibly leucocytes could be found in many specimens. One specimen, No. 80, at the 20 day period showed a globular enlargement about 1 centimeter in diameter just distal to the point of ligation (Fig. 20). The wall of this cavity was lined in part with epithelium resting on a connective tissue base (Fig. 21). It shelled out quite readily from the surrounding tissue. In contrast to this specimen, No. 81 at the 22 day period contained a grossly similar distal distention which proved to be very different in character. That part of the duct

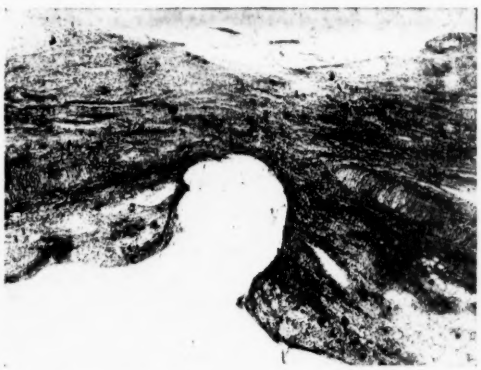

Fig. 12. Photomicrograph of the zone of ligation demonstrating proximal and distal necrosis with adjacent exudate which can not be distinguished from the duct wall. (Day 6.)

showed extensive necrosis and there was no lining epithelium or definite connective tissue wall.

DAYS 20 to 33. During this period the exudate showed evidence of further absorption and organization so that the remnant of fibrosed duct became involved in an organizing mass of connective tissue adherent to the adjacent liver (Figs. 22, 23, 24, and 25). Areas of leucocytic infiltration with here and there areas of necrosis were still present, and the adjacent liver showed areas of leucocytic infiltration in the immediate vicinity.

CORRELATIVE OBSERVATIONS

It was observed in a number of the experiments that on about the fifth day after operation, the duct was very brittle and broke

Fig. 14. Low power photomicrograph showing the extensive necrosis beneath and distal to the ligature. This photograph clearly demonstrates that at this period the changes within the duct have not occluded the lumen at the site of ligation. (Day 7.)

Fig. 13. Photomicrograph depicting the extensive cellular infiltration of the area of the duct within the grasp of the ligature. 225 diameters. (Day 6.)

at the point of ligation. An attempt was made to determine whether the intrabiliary pressure might be sufficient to rupture the duct at this point. In animal No. 65, 4 days after cholecystectomy, the common duct was cannulated and the intraductal pressure was raised to 152 millimeters of mercury. At this level the animal suddenly died. The duct did not rupture at the point of ligation but a small perforation took place about 4 millimeters proximal to the ligature. In this experiment

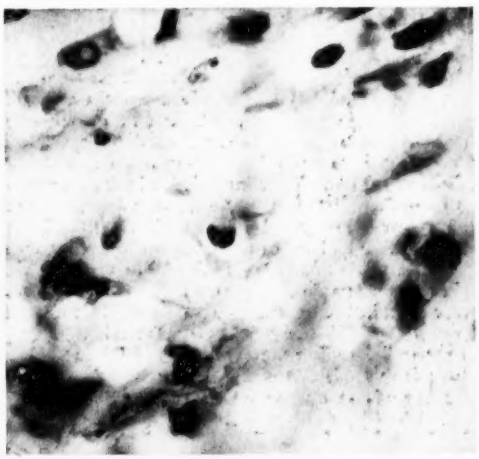

Fig. 15. Photomicrograph showing young connective tissue cells in the exudate. 1,200 diameters. (Day 7.)

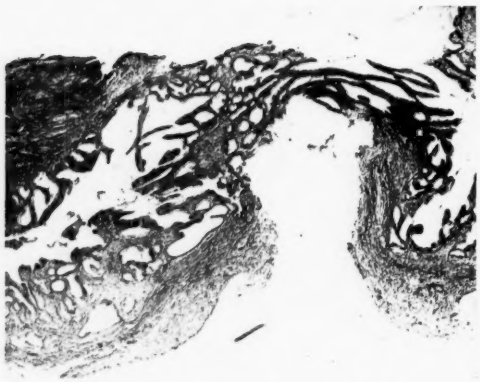

Fig. 16. Low power photomicrograph of the zone of ligation showing the absence of the muscular coat with the mucous membrane intact. (Day 9.)

the cystic artery was not separately ligated. In animal No. 66 on the fourth postoperative day the same procedure was applied and the pressure was raised to 168 millimeters of mercury with no leakage or rupture of the duct. In this experiment the cystic artery was tied close to the common duct. In animal No. 69, 4 days after cholecystectomy, the same experiment was applied with 176 millimeters of mercury pressure and the duct remained intact. In animal No. 70, 4 days after operation, 168 millimeters of mercury pressure

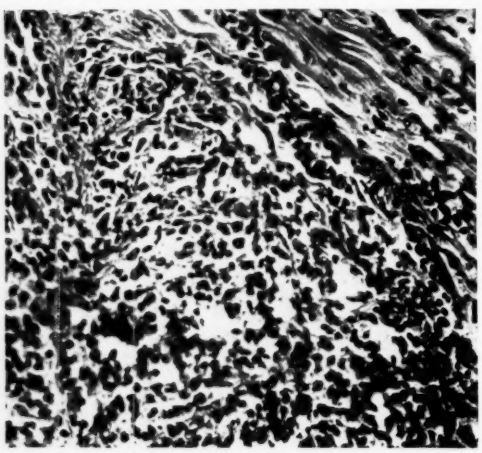

Fig. 18. Photomicrograph showing the cellular elements and beginning organization of the exudate. 240 diameters. (Day 10.)

Fig. 17. Low power photomicrograph through the zone of ligation. This shows a cross section of the ligature on either side with fragmentation of that portion of the duct within its grasp. The ligature and duct are well surrounded by the exudate. (Day 10.)

was introduced and the duct remained intact. Animal No. 73, 5 days after cholecystectomy, withstood 160 millimeters of mercury pressure without rupture of the duct. Animal No. 71, on the sixth postoperative day, withstood 170 millimeters of mercury pressure. In animal No. 72, 6 days after operation, when the pressure was raised to 66 millimeters of mercury pressure there was leakage at the point of ligation. In animal No. 75 the duct was loosely ligated and on the seventh day after operation the intraductal pressure was raised to 66 millimeters of mercury. At this level, leakage took place through the end of the stump. The duct was then freed and the pressure increased with no leakage at the site of ligation but free flow of water from the end. In animal No. 74 the duct was also quite loosely ligated at the time of the cholecystectomy and on the ninth postoperative day the common duct was cannulated and when the pressure was raised to 108 millimeters of mercury, leakage took place through the end of the duct stump but not at the site of ligation. The duct had not been freed from the exudate. When the specimen was removed for study it was found to contain only a mucous membrane tube at the site of ligation, the outer layers having entirely disappeared (Fig. 16).

In several instances gauze drains were inserted to the ligated duct and were removed on the third postoperative day. Invariably these specimens showed excessive adhesions

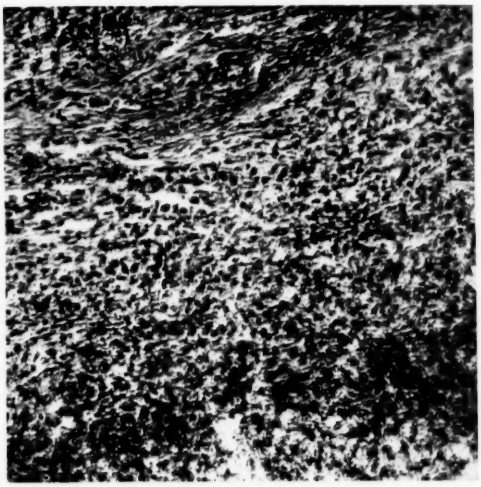

Fig. 19. Photomicrograph of the exudate. 250 diameters. (Day 14.)

of the surrounding viscera with at times cavity formation about the site of the duct stump. In one 10 day specimen a sinus tract with necrotic walls led to the ligated duct. In all these specimens it appeared that the gauze drains either prevented exudate deposit or drained away the exudate about the duct and prevented the adjacent structures from covering the duct stump. In one specimen the area of ligation appeared to lie in a small abscess cavity.

IMPRESSIONS

From a study of the gross and microscopical evidence of the experiments reported and from a knowledge of the anatomical relations, the following résumé may be offered:

The cystic duct receives its major blood supply through small branches of the cystic artery. When the cystic artery is ligated well proximal to the point of duct ligation that portion of the duct which is distal to the ligature is deprived of its blood supply while that portion which is proximal to the ligature has a variable amount of decreased blood supply depending upon the amount of duct which is dissected free from the surrounding tissue, the location of the ligation of the cystic artery, and the size and number of the arteries which may lie in the wall of the cystic duct.

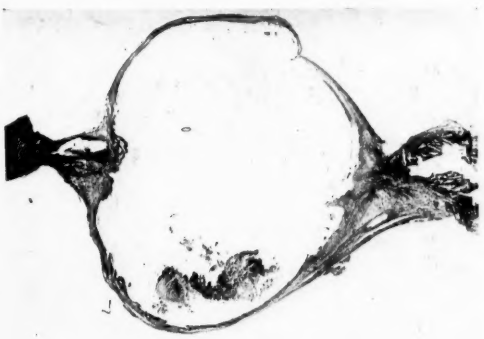

Fig. 20. Low power photomicrograph showing the cyst in the duct distal to the ligature. (Day 20.)

Immediately after cholecystectomy the duct stump is covered by an exudate consisting of serum, red blood cells, and leucocytes. In a considerable number of cases red blood cells overshadow the other elements. Adjacent liver lobes cover over the stump and the exudate and the stump of the duct undergoes aseptic necrosis with leucocytic infiltration and partial absorption. The extent of the necrosis depends upon the blood supply. It has been shown that the process extends well proximal to the ligature, and I am inclined to believe that the distance is controlled entirely by the extent of free dissection of the cystic duct, this factor determining the nutrition of the duct. The more duct which is dissected free proximal to the ligature the farther proximal the necrosis extends.

In a few days young connective tissue cells begin to make their appearance in the exudate.

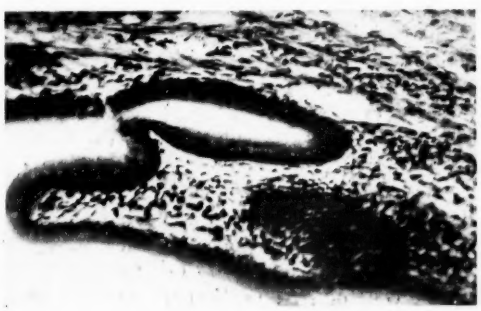

Fig. 21. Photomicrograph demonstrating epithelium lining a portion of the inner wall of the cyst. 200 diameters. (Day 20.)

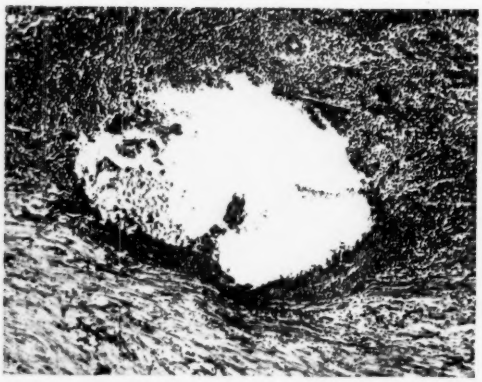

Fig. 22. Low power photomicrograph showing ligature buried in the organizing exudate. (Day 27.)

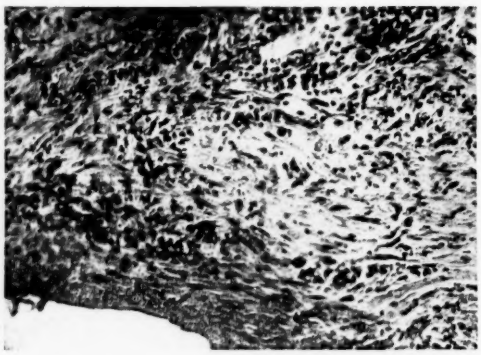

Fig. 23. Photomicrograph demonstrating the organizing exudate. 175 diameters. (Day 27.)

These cells grow from the viable structures adjacent to the exudate and in this manner the exudate becomes organized and vascularized. The duct stump which has been shown to be undergoing necrosis and absorption may receive a variable amount of nourishment from the surrounding exudate and viable structures but as a rule it is invaded by leucocytes and has a tendency to become sclerotic and absorbed and finally to appear as a mass of scar tissue imbedded in the organized exudate and adjacent infiltrated and sclerotic tissue. Certain cells may remain viable and may eventually become nourished, and young cells may form to the extent of vitalizing portions of the duct stump as evidenced by specimen No. 80 containing the cyst (Figs. 20 and 21).

From our studies it would appear that the cellular proliferation in the duct proximal to the ligature is usually considerably delayed if at all present and is not the essential factor in the duct repair or obliteration but that the organization of the exudate about the duct is the all important process. Any procedure or process which prevents or disturbs this exudate interferes with the prompt, certain, and secure closure of the duct. Our studies upon drained preparations verify this conclusion.

The cells of that portion of the duct wall which is within the grasp of the ligature become atrophic, the cell structure becoming obscure, leaving only collagenous material as a frame work. These collagen fibers, as a rule, have enough tensile strength to hold the duct in position and prevent egress of bile under ordinary pressure. That conditions may obtain which cause the duct to rupture at the site of ligation is evidenced in animal No. 47 which died about 60 hours after operation. At autopsy the belly was found filled with a bile stained fluid and the duct was open at the site of the ligation. Moreover, in animal No. 72 the duct ruptured at the point of ligation with a pressure of 66 millimeters of mercury which is the equivalent of 850 millimeters of water. It has been shown that in man the sphincter of Oddi will withstand a pressure of 500 millimeters of water and that in the animal during vomiting the pressure is often very suddenly raised to 1,000 millimeters of water pressure. It may be surmised, therefore, that conditions may arise which will cause a rupture of the duct at the site of ligation.

From our observations on the friability of the duct at the point of ligation on the fourth to the sixth days, it would seem that but little trauma is necessary to bring about a break in its continuity and that the repair within the duct at this time is by no means sufficient to seal off the lumen so as to prevent bile leakage. Vomiting, coughing, or sudden movements may be sufficient to supply this. The constant movement of the liver due to the respiratory excursion may also be a factor. Whether the

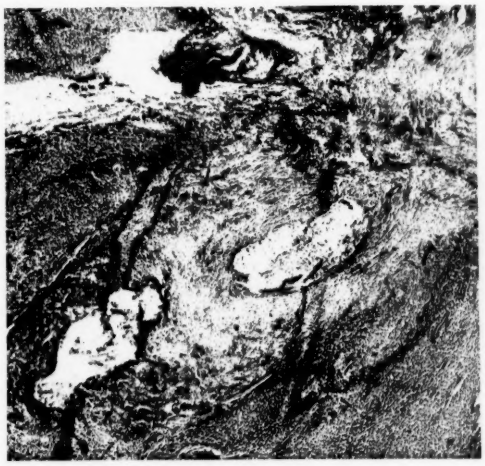

Fig. 24. Low power photomicrograph showing the ligature buried in fairly well organized tissue. (Day 33.)

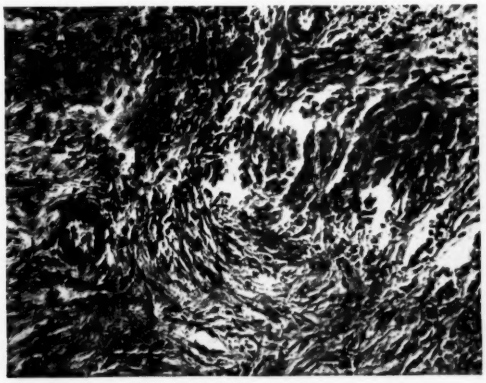

Fig. 25. Photomicrograph demonstrating the well organized character of the exudate. This shows several well formed blood vessels. 175 diameters. (Day 33.)

bile has an inhibitory action so far as duct repair is concerned is a question well deserving study for it has been shown that bile is toxic to body tissues and it is reasonable to assume that in the presence of decreased blood supply of the duct wall the bile may exert a destructive influence.

When this evidence is viewed in the light of human anatomy and physiology, certain factors and conditions must be taken into consideration. Anatomical differences have been alluded to. In the human, when the cystic duct is isolated during a cholecystectomy, it is often deprived of all its peritoneal coat and surrounding cellular tissue. There seems little question but that the serous coat is a most essential structure in the repair of all abdominal viscera. When the duct is freely separated, the only blood supply remaining is that within the duct wall. Since the necrosis depends upon altered blood supply, the more of the duct which is dissected free proximal to the site of ligation the more proximal the necrosis will extend. Moreover, in the human there is less tendency for the liver to cover the stump of the duct although the structures of the duodenohepatic ligament may do so. This structure may and no doubt does function in this respect as does the liver in the dog.

Any inflammatory process of an acute nature may cause liquefaction of the exudate and thus interfere with the normal process of organization. As has been stated before there seems little question but that drainage material which leads to the duct stump is undesirable because of the interference with the formation and deposition of the exudate. It is problematic as to how much exudate will form 72 hours after the gall bladder has been removed; moreover, if a drain is removed at this time it is possible for the trauma to rupture the duct which is unprotected by a sleeve of exudate which normally at this time should be fairly secure. If a drain is employed it should be placed well away from the duct stump so that it can in no way interfere with the formation of the exudate or with the collapse of the surrounding structures over the duct stump.

SUGGESTIONS AND CONCLUSIONS

The cystic duct stump after a cholecystectomy occludes itself by a process of organization of the surrounding exudate which is covered with and protected by adjacent living structures.

If the major bile ducts have not been injured at the time of operation, or if accessory ducts have not been left open, copious bile leakage after cholecystectomy is due to rupture of the cystic duct at the site of ligation.

Since the cystic duct stump undergoes aseptic necrosis due to deprivation of its blood supply, care should be exercised in its dissection and only a sufficient portion of the duct should be separated to ascertain its identity and the ligature should be placed at the point of contact with undisturbed proximal tissues. A single ligature, not too tightly tied, is sufficient to prevent leakage. Multiple ligatures are contra-indicated and transfixion will not add to the security of the closure.

In anticipation of bile leakage, drainage should be used only when the duct wall is very friable or extensively changed by a pathological process and should be so placed that it will not interfere with the formation and deposition of the exudate about the duct or prevent the collapse of the surrounding tissues upon the duct. I am inclined to believe that only rarely is drainage required.

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BILE IN INTESTINAL OBSTRUCTION—EXPERIMENTAL OBSERVATIONS[1]

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MUCH experimental work has been done on intestinal obstruction. We have attempted to determine what rôle bile plays in cases of obstruction. Before discussing our experiments, it seems advisable to recount some of the previous findings.

Haden and Orr called attention to the loss of chlorides and the rise in non-protein nitrogen of the blood in cases of intestinal obstruction. Foster and Hausler, however, did not believe that hypochloræmia was present in uncomplicated cases and felt that no toxæmia was present, but rather dehydration and starvation. They maintain that there are two types of obstruction: (1) acute simple obstruction and (2) acute strangulation. Gatch, Trusler, and Ayers have the same general classification and feel that in (1) death is due to dehydration and reduction of chlorides; but in (2) toxæmia is present.

Considering the toxic element, there is much in the literature. It has been considered to have its origin in protein decomposition in the bowel, and the intervention of bacteria thought to be necessary in the production of the toxic substance. Stone, Bernheim, and Whipple have thought that the mucosa and not the bowel content furnished the absorbed toxin. Wagensteen and Chun have concluded that all intestinal contents are toxic on injection, even without the presence of obstruction. Both McClure and Gerard have brought out the importance of bacteria in the obstructed loop as a producer of the toxic factor. Murphy and Brooks recognize this toxic substance but feel that it is not absorbed through normal mucosa.

Sweet, Peet, and Hendrix attributed the toxæmia to the action of the pancreatic enzyme on the proteins present in the duodenum. Previous ligation of the pancreatic ducts prolonged life in the obstructed animals. Dragstedt et al. have called attention to the condition of the intestinal wall leading to the obstruction. Gatch, Trusler, and Ayers found that, in closed loops of the jejunum and ileum, death was always preceded by gangrenous changes in the loop. They concluded that the toxic elements are caused by the bacterial action on the obstructed loop and are not absorbed by normal mucous membrane, but only after tissue necrosis occurs.

In our own experiments it would seem, however, that there is an added factor not yet brought out in cases of simple obstruction. Whether toxæmia is present or not, it would appear that supplying bile to the intestine below obstructions of the small intestine improves the animal's clinical condition and prolongs life. Eisberg produced obstruction in dogs just below the bile ducts and at the pylorus and found the latter to live considerably longer. Brockman feels that bile may be needed in contact with the intestinal mucosa. He also feels that cases of paralytic ileus, clinically, were greatly benefited by rectal injections of bile.

It was Hartwell and Hoguet who first called attention to the value of sodium chloride in prolonging life in cases of obstruction. Foster and Hausler, and also Wagensteen and Chun, have shown that if saline is administered for a few days after obstruction, it may be discontinued with the same prolongation of life as though it were continued. They both feel that sodium chloride is not detoxifying, but they look upon it as do Haden and Orr, McCallum et al., and Gamble and Ross as fulfilling a replacement function.

In our own experiments, twenty-three dogs were used. There were several complications of operation, such as peritonitis or pancreatitis which necessitated the discarding of several protocols from our results. Different level obstructions were done and different follow-up care was given. The length of life was taken as the titration point of the experiment.

The type of obstruction we produced was of the simple type (proved at autopsy); the lumen was cut across and the proximal end closed; the distal end in most cases was used

[1] A preliminary report. From the Buhl Laboratory of Harper Hospital, Detroit.

TABLE I.—TYPE OF OBSTRUCTION

	Duodenal	Jejunal (high)	Pyloric	Sigmoid
Experiments performed	10	9	3	1
Controls	3	2	..	1
Human bile	3	5	..	..
Solution of desiccated ox-bile	3	1	..	..
Complications	1	1	3	..

TABLE II.—DURATION OF LIFE

Site of obstruction	Duration of life Controls Days	Average	Duration of life Human bile given Days	Average
Duodenal	4 3½ 1½	3 days	5½ 8 7½	7 days
High jejunal	3½ 2½	3 days	14 6½ 4½ 4‡	7 days (plus)*
Sigmoid	5½	5½ days		

*There was also a dog which lived 21½ days treated with bile, and saline by enterostomy (third day) and by hypodermoclysis (starting on the tenth day), which was therefore not included.

‡Eviscerated on the 4th day although previously in good condition.

TABLE III.—DOG 126, DUODENAL OBSTRUCTION. CONTROL WATER GIVEN THROUGH ENTEROSTOMY

Day	Water (oz.)	Human bile	Blood non-protein nitrogen	Blood chlorides	Condition
Day of operation	..	..	33.4	300	....
First	8	0	54.5	200	Fair to good
Second	8	0	43	200	Good
Third	8	0	112.5	180	Fair
Fourth	10	0	141.2	100	Fair to poor death

TABLE IV.—DOG 121, DUODENAL OBSTRUCTION. HUMAN BILE GIVEN THROUGH ENTEROSTOMY

Day	Human bile (oz.)	Blood non-protein nitrogen	Blood chlorides	Blood CO_2 per cent	Condition
Day of operation	..	60	325	..	....
First	10	94.5	233	..	Good
Second	10	160	183	69	Fair
Third	7	129	162	..	Fair to good
Fourth	10	..	...	..	Fair
Fifth	10	129	166	..	Fair
Sixth	10	150	...	..	Fair to poor
Seventh	..	.....	...	..	Fair to poor
Eighth	..	.....	...	..	Death

TABLE V.—DOG 114, HIGH JEJUNAL OBSTRUCTION. CONTROL SALINE GIVEN THROUGH ENTEROSTOMY

Day	Saline ounces	Human bile	Blood non-protein nitrogen	Blood chlorides	Condition
First	8	0	27.3	300	Good
Second	8	0	30	314	Good
Third	8	0	25	...	Good
Fourth	..	0	....	...	Death

TABLE VI.—DOG 122, HIGH JEJUNAL OBSTRUCTION. HUMAN BILE GIVEN THROUGH ENTEROSTOMY

Day	Human bile (ounces)	Blood non-protein nitrogen	Blood chlorides	Condition
First	10	33.4	200	Good
Second	10	40	243	Good
Third	10	40	275	Good
Fourth	10	35.3	260	Good
Fifth	10	54.5	250	Fair to Good
Sixth	10	....	142	Fair
Seventh	10	....	...	Fair
Eighth	10	37.3	...	Fair
Ninth	10	33	133	Fair
Tenth	10	62.5	...	Fair
Eleventh	10	43	270	Fair
Twelfth	10	67	144	Fair
Thirteenth	10	129	66.6	Fair
Fourteenth	10	....	....	Death

to make an enterostomy. In some cases human bile, obtained from operative cholecystostomy drainage cases, was given into the enterostomy. In others, ox-bile solution, made from desiccated ox-bile, was used. In still others, saline was given into the enterostomy in amounts equivalent to those of bile. In some cases nothing was given. In one case, saline was given subcutaneously to a dog who had been getting bile. The tables may be seen for examples of individual experiments.

On the average, the dogs given bile into the intestinal tract lived twice as long as the dogs with the same type of obstruction who did not receive bile. We found, as have others, that in general the non-protein nitrogen tended to increase and the chlorides to decrease after obstruction.

The solution of desiccated ox-bile as used by us was harmful rather than beneficial in prolonging life and caused a diarrhœa of the segment below the obstruction and an appreciable clinical change for the worse. On the other hand, human bile seemed to cause a very

quick change for the better in obstructed animals. They appeared brighter and were able to walk back to their stalls, whereas it had been necessary to carry them to the board where the bile was given. As has been mentioned, on the average they lived twice as long as those who did not get the bile. In some of the cases an animal which had been getting the bile was allowed to go for a period of 24 or 36 hours without it and then, on injecting it, the most marked effects for the better were noted.

We do not attempt to detract from the great place that sodium chloride has won in these conditions. We realize that its protective mechanism is very great, but we do feel that bile is also of the same nature. We think, as do others, that the action of sodium chloride may be that of substitution for depleted chlorides rather than an action of detoxification.

The exclusion of bile from a reasonably large segment of intestine may deprive the body of factors that are badly needed under these circumstances. This may be a deprivation phenomenon, or the bile may have a detoxifying action. The cycle of bile salts, in which they are excreted in the liver and re-absorbed by the intestine, is broken up by the intestinal obstruction, since the bile salts are lost by vomiting. This, therefore, may be a causative factor in the toxæmia. This also may explain the quicker fatality of the higher obstructions, as well as the great difference in the picture of complete pyloric obstruction from that of a high intestinal one.

CONCLUSIONS

1. In a limited number of experiments, it appeared that the presence of human bile in the intestinal tract of dogs with intestinal obstruction caused the obstructed dogs to live longer than those who were not so treated. These animals seemed clinically better after such treatment.

2. We may consider this action as one of substitution of missing factors, as is the action of sodium chloride, or we may consider it as a detoxifying factor.

3. Further investigation is necessary and is being carried on.

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PREVESICAL, PERIVESICAL AND PERIPROSTATIC SUPPURATIONS

Review of Literature and Report of Cases

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CAREFUL scrutiny of the literature of the past 25 years reveals a decided paucity of recorded observations of local complications following the various operations on the bladder, prostate, and urethra. This is surprising in view of the vast number of operations that have been performed on these organs for various reasons during this period. Fortunately, the perfection of technique for all such work has been stressed so long that the occurrence of these disagreeable complications has been rare. This is perhaps due to the fact that the genito-urinary surgeon of today takes the necessary precautions to prevent the appearance of such complications and is on guard to institute immediate and energetic treatment to eradicate them at the earliest moment. These local accidents can occur after cystotomies, cystostomies, cystectomies, and prostatectomies and are always serious and often terminate fatally.

To the French writers is due the credit for bringing the subject, to the attention of the genito-urinary surgeon. They have written extensively on the subject, not only from the clinical but also from the anatomical and experimental standpoints. They stress particularly the relation of pelvic suppuration to prostatic abscess. Among the contributors to the various phases of the subject it is necessary to cite among others Denonvilliers, Charpy, Velpeau, Civiale, Phillips, Faucon, Reliquet, Demarquay, Segond, Proust, Campenon, Desnos, Albarrans, Guyon, Minet, Aversenq, Legueu. The American writings on this subject have dealt chiefly with localized periprostatic suppurations following abscess of the prostate. However, within recent years, a greater interest has been shown by American workers and important contributions to the anatomical and pathological aspect of this subject have been made by Young, Caulk, Chute, Wesson, Herman, Morrissey, Greenberg, Culver and Baker, and others.

This paper is particularly concerned with the development of postoperative infections in the various spaces about the bladder and prostate following suprapubic and perineal prostatectomy or following any of the preliminary procedures prior to prostatectomy.

ANATOMY AND TOPOGRAPHY

From a clinical and surgical point of view it is important to recognize the origin, pathway of infection, and localization of suppurative conditions which occur in and about the prostate either before or after operation.

A knowledge of the aponeuroses which surround the prostate and the spaces enclosed within these aponeuroses is very essential, because of the rôle these structures play in the development and localization of collections of pus about the prostate. Consequently, a brief description of the anatomy and topography of these structures is in order.

The pelvic fascia (Figs. 1 and 3). The brilliant studies of Wesson have aided greatly in presenting a clear conception of the pelvic fascia. It is made up of a parietal and a visceral layer. The parietal portion is continuous with the psoas and iliac fascia and is attached to the promontory of the sacrum and the iliopectineal line. It then passes down over the posterior pelvic walls to cover the pyriformes muscles and the sacral and pudendal plexuses of nerves. As it passes over the lateral pelvic walls it covers the obturator internus muscles, and, at the level of the line extending from the lower part of the symphysis pubis to the spine of the ischium (the so-called white line of the pelvic fascia), it divides into two layers. The more external of these two layers is called the obturator fascia and passes downward over the inner surface of the obturator internus muscle to form the outer wall of the ischiorectal fossa. The inner wall of this fossa is lined with the ischiorectal fascia, which is a part of the parietal layer of

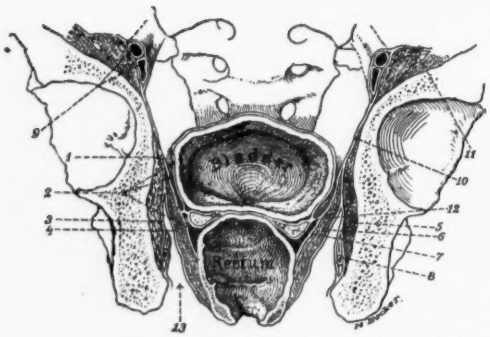

Fig. 1. Vertical section through the pelvis, showing relation of fascial layers to pelvic wall and floor (after Deaver's *Surgical Anatomy*). *1*, White line; *2*, rectovesical fascia (superior fascia of pelvic diaphragm); *3*, obturator fascia; *4*, ischiorectal or anal fascia (inferior fascia of pelvic diaphragm); *5*, obturator internus muscle; *6*, levator ani muscle; *7*, seminal vesicles and vas deferens; *8*, internal pudendal vessels in Alcock's canal; *9*, external iliac vessels; *10*, pelvic fascia; *11*, iliac fascia; *12*, endopelvic fascia; *13*, ischiorectal fossa.

the pelvic fascia. This external layer (obturator fascia) is continuous across the anterior part of the pelvic outlet with the corresponding fascia of the opposite side and thus forms the deep layer of the triangular ligament.

The inner layer is known as the visceral layer and is sometimes described as the rectovesical fascia but is essentially a continuation of the pelvic fascia. The visceral layer serves as a membranous diaphragm separating the pelvic cavity above from the perineum below. The visceral layer passes downward and inward upon the upper (or pelvic) surface of the levator ani muscles and then passes over the surface of the prostate gland, seminal vesicles, bladder, and rectum. This fibrous covering is often termed the endopelvic fascia.

The term, "rectovesical fascia," has been restricted within recent years to that portion of the fascia which lies between the rectum and bladder and which encloses the seminal vesicles. This layer is of utmost importance in connection with the direction and course of suppurative lesions following operations upon the bladder and prostate.

The visceral layer of the pelvic fascia is made up of numerous fascial planes or bands which divide the pelvis into separate compartments and as such will be described later under the heading of anterior, lateral, and posterior periprostatic fascias. In the posterior part of the pelvis, the visceral layer of the pelvic fascia is pierced by the rectum and is reflected upon the rectum as the rectal or prerectal fascia.

As the visceral fascia passes inward from the white line on either side, it passes upon the posterior surface of the bladder and turns upward upon the base and sides of the bladder to form the lateral true ligaments of the bladder. When the fascia reaches the junction of the prostate and bladder, it splits into two layers, one passing up over the bladder as the vesical fascia, which contributes to the fibrous coats of that organ, and the other passes downward upon the prostate enveloping that organ in a loose sheath, the constituent parts of which are known as anterior, lateral, and posterior periprostatic fascias (Fig. 2). The portion of the visceral layer enveloping the prostate becomes continuous at the apex of the prostate with the deep layer of the triangular ligament (a part of the parietal pelvic fascia) and is continued forward in the form of two bands known as the anterior true ligaments of the bladder.

The portion of the visceral layer covering the bladder splits on either side of the midline to enclose each seminal vesicle and vas deferens and also gives rise to a layer of fascia that forms the outer coat of the ejaculatory duct as it passes through the prostate.

The prostate gland snugly encircles the posterior urethra and the vesical neck, and the intimate relation of these structures serves to explain why the posterior urethra and bladder are so frequently the origin of suppurative lesions of the prostate. The prostate is composed of large tubular glands situated in the deepest portion of the gland and connected to the posterior urethra by long ducts. The stroma of the gland is made up of fibrous connective tissue and smooth muscle fibers. It is by the contraction of these muscle fibers that the secretions are expressed from the acini through the ducts into the posterior urethra during the normal physiological activity of this gland.

The true capsule of the prostate is a well defined fibromuscular membrane which surrounds the entire gland except at its base and

apex where the urethra pierces the gland. This fibromuscular capsule is continuous on its internal aspect with the fibromuscular stroma of the gland and on its external aspect with the fibromuscular tissues that unite the prostatic capsule with the periprostatic sheaths or aponeuroses and the cellular spaces. The firmness and integrity of this capsule serves a useful purpose in limiting the extension of a suppurative process within the gland and accounts for the tendency of intraprostatic suppurations to rupture internally into the urethra instead of into the loose periprostatic tissue.

The prostate is closely surrounded on all sides by fascial sheaths (Fig. 2) or aponeuroses except at its upper and lower portions where the prostate fuses with the bladder and the membranous urethra respectively. The aponeuroses have been properly classified by Aversenq from their anatomical relation to the prostate: (1) anterior periprostatic aponeurosis or fascia, (2) lateral periprostatic aponeurosis or fascia, (3) posterior periprostatic aponeurosis or fascia, and (4) median aponeurosis (part of triangular ligament).

The anterior periprostatic fascia (Figs. 2 and 3). The anterior periprostatic fascia is also known as the puboprostatic fascia of Denonvillier or fascia of Zuckerkandl or the fibrous preprostatic fascia of Delbet. It extends from the anterior surface of the bladder to the posterior surface of the pubis at its lower border. It lies a few millimeters in front of the prostate and covers the venous plexus of Santorini. Laterally this sheath blends with the aponeuroses of the levator ani and posteriorly it fuses with the prevesical fascia of Charpy. The lowest portion of this sheath is separated from the prostate by the striated muscle fibers of the external sphincter and the posterior urethra in the region of the apex of the prostate. The actual width of the anterior periprostatic fascia is scarcely more than 1 centimeter and it occupies the space between the anterior ligaments of the bladder which extends from the bladder to the posterior surface of the pubis and to the prostate. The anterior periprostatic fascia appears to be a thin layer of fibrous tissue

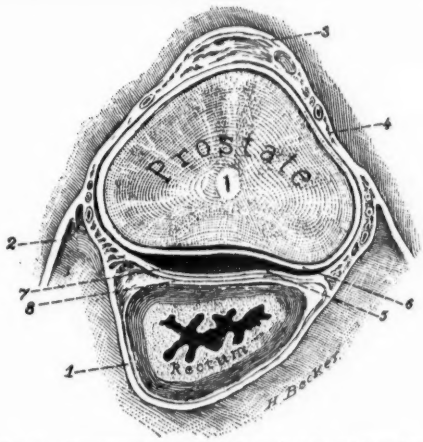

Fig. 2. Transverse section through the midportion of the prostate to show the relation of the periprostatic fascias (after Aversenq and Dieulafe). *1*, Fascia recti; *2*, fascia of the levator ani (endopelvic fascia); *3*, anterior periprostatic fascia; *4*, lateral periprostatic fascia; *5*, posterior periprostatic fascia—2 layers (fascia of Denonvilliers); *6*, capsule of the prostate; *7*, posterior periprostatic space (or retroprostatic separable space); and *8*, prerectal fascia.

but is quite resistant as evidenced by the rarity of extension of inflammations beyond it during and after perineal operations. The dorsal veins of the penis pierce it to reach the venous plexus at the base of the bladder.

The lateral periprostatic fascia (Fig. 2). The lateral periprostatic fascia is also known as the puborectal fascia of Denonvilliers. This fascia is rather intimately united to the prostate by loose connective tissue through which run the veins found on the lateral aspect of the gland. The lateral periprostatic fascia is essentially an extension of the fascia of the levator ani. It is composed of a horizontal and a vertical portion, continuous with one another. The horizontal portion at its inferior aspect blends with the superficial layer of the triangular ligament and at its superior aspect is continuous with the inferior border of the levator ani muscle. At the posterolateral angle of the prostate the deep layers of the lateral periprostatic fascia fuse with the fibrous elongations from the posterior periprostatic and prerectal fascias and continue on anteriorly to the region of the bladder.

The vertical portion is almost quadrilateral in shape and extends from the side of the

symphysis pubis to the region of the rectum and levator ani. It extends from anterior perineal fascia (combined anterior ligaments of the bladder and the anterior periprostatic fascia) down to the deep layer of the triangular ligament. On its external surface it is intimately adherent to the levator ani and on its internal surface is separated from the membranous urethra by striated muscle fibers of the external sphincter.

The posterior periprostatic fascia (Figs. 2 and 3). Originally the posterior periprostatic fascia was described as the prostatoperitoneal fascia of Denonvilliers and now is commonly known as the fascia of Denonvilliers. This fascia covers the posterior surface of the prostate, seminal vesicles, and bladder. At its posterior border it fuses with the subperitoneal tissue of the rectovesical cul-de-sac, and at its anterior border it is inserted on the muscular sheath of the membranous urethra just below the apex of the prostate. Laterally this fascia blends with fascial elongations from the levator ani and fascia recti, the union taking place at the posterolateral angle of the prostate just below the vein which is commonly found in this position. In the region of the seminal vesicles, the fascia of Denonvilliers is firmly adherent, due to the numerous fibrous adhesions between these structures.

The fascia of Denonvilliers is a firm, dense sheath composed of fibrous and elastic connective tissue. The elastic fibers impart the characteristic shiny appearance of this fascia. This fascia is most marked and thickest in the midline and may contain muscle fibers in its lateral aspects especially in well developed individuals. The fascia is composed of two layers: an anterior layer and a posterior layer. The anterior layer covers the prostate; the posterior layer covers the rectum. Between those two layers is a potential space. The anterior layer is thicker and more resistant than the posterior layer. The ejaculatory ducts receive an investment from this fascia as they traverse the prostate. It was formerly believed that the fascia of Denonvilliers was formed by a fusion of the two layers of fetal peritoneum (Cuneo and Veau). However, Wesson has shown in his classical studies that this fascia is formed by a condensation of mesenchymal tissue occurring subsequent to the formation of the urethra.

The median fascia. This fascia represents the inferior layer of the triangular ligament. The triangular ligament is also described as the ligament of Carcassone, the median-perineal fascia of Blandin, the anopubic fascia of Velpeau, but more commonly known as the triangular ligament of Colles. It is composed of two layers of fibrous tissue which occupy the interpubic arch. The inferior layer (or median fascia) is the strongest and most resistant of the two. The superior layer is only a cellular sheath covering the transverse perinei muscles. Between the two layers are found muscular fibers running in different directions, which have their origin in the anal sphincter or transverse perinei muscles, and are prolonged on to the bulb as the recto-urethralis muscle fibers. The internal pudendal artery, the two veins to the bulb with its smaller branches, and the two glands of Cowper first traverse the space between the two layers of the triangular ligament and then pierce the ligament itself.

These fascial sheaths on the superior, inferior, and lateral aspects of the prostate gland inclose a potential quadrangular space about the prostate recognized by the French writers as *la loge prostatique.* These intrafascial spaces are: in front, the anterior periprostatic space; on the sides, the lateral periprostatic space, and behind, the posterior periprostatic space. The extra-aponeurotic spaces are situated behind the periprostatic aponeuroses and consequently are found behind the aforementioned spaces; these are, in front, the anterior extraprostatic space, or space of Retzius, laterally, the superior pelvirectal space, and behind, the posterior extraprostatic space or prerectal space.

Anterior prevesical space (Fig. 3). This area is commonly called the space of Retzius and is the most frequent site of localized postoperative infections. The space of Retzius is one of three spaces found anterior to the bladder resulting from the division of the transversalis fascia. The fascia covering the posterior surface of the upper portion of

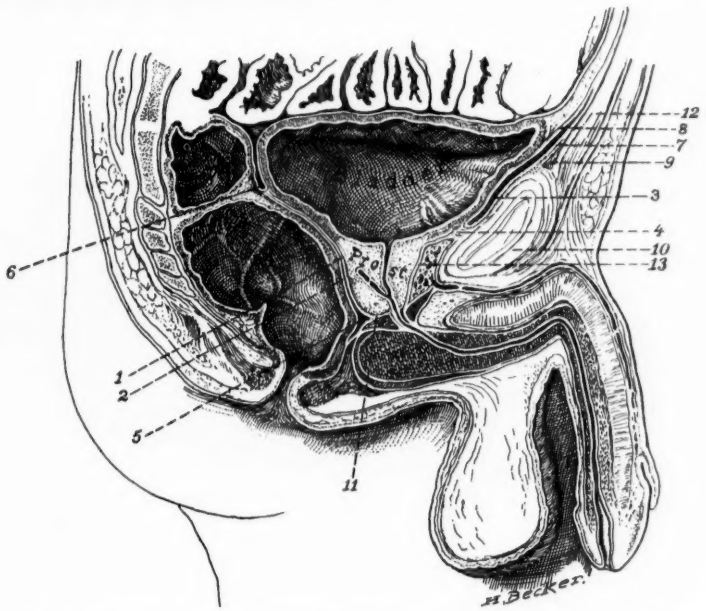

Fig. 3. Drawing to show the various fascias concerned in the formation of the potential separable spaces about the bladder and prostate (after Deaver's *Surgical Anatomy*). *1*, Capsule of prostate and posterior bladder wall; *2*, posterior periprostatic (Denonvilliers') fascia; *3*, prevesical space (space of Retzius); *4*, anterior (pubo-prostatic) ligament of bladder; *5*, retrovesical separable space; *6*, rectovesical peritoneal fold; *7*, anterior layer of transversalis fascia; *8*, posterior layer of transversalis fascia; *9*, retromuscular space; *10*, pubic bone; *11*, triangular ligament; *12*, rectus muscle; and *13*, anterior periprostatic fascia.

the recti muscles ends just below the umbilicus at the semilunar fold of Douglas; extending downward from this point are two thin layers of transversalis fascia. The anterior layer covers the posterior surface of the lower portion of the recti muscles and is attached to the superior border of the symphysis pubis. The posterior layer passes down over the bladder to fuse with the visceral layer of the pelvic fascia. Between the anterior layer of the transversalis fascia and the posterior surface of the lower portion of the recti muscles is the so-called retromuscular space (Fig. 3).

The prevesical space of Retzius is bounded anteriorly by the symphysis pubis and the anterior layer of the transversalis fascia; posteriorly, by the posterior layer of the same fascia; superiorly, by the fusion of the two layers of transversalis fascia at the semilunar fold of Douglas; inferiorly, by the anterior periprostatic fascia; and laterally, by the fusion of the two layers of the transversalis fascia with the aponeuroses of the transversalis and oblique muscles.

The third space situated anterior to the bladder is called by Aversenq the anterior perivesical space which is essentially a continuation of the anterior periprostatic space. The boundaries of this space are: anteriorly, the prevesico-pelvic sheath (posterior layer of transversalis fascia) which fuses with the anterior periprostatic fascia; behind, the symphysis pubis; superiorly, the peritoneum; and posteriorly, the bladder musculature.

The recto-urethralis muscle is essentially a group of smooth muscle fibers having its origin in the anterior, thickened, longitudinal band of the rectum at the level of the verumontanum. It passes forward over the

posterior surface of the prostate to fuse with the raphé of the external vesical sphincter.

The levator ani muscles (Figs. 1 and 4) are lateral to the prostate and distinctly separated from it. The levator ani does not contribute any fibers to the recto-urethralis muscle. Morrisey describes the origin of this muscle: this muscle has an extensive origin; in the front, from the posterior surface of the pubis near the symphysis; behind, from the spine of the ischium; and between those points from the pelvic fascia along the line of attachment of the obturator fascia. From these points the muscle fibers pass downward and inward toward the middle line of the floor of the pelvis. Some of the fibers of this muscle fuse with the external vesical sphincter and the deep transverse perineal muscles. The levator ani of either side gives off fibers which, after passing around the prostate and urethra, descend between the rectum and genito-urinary passage.

ETIOLOGY

The mechanism of the development of inflammatory lesions about the prostate and bladder, following any operative procedure on these organs and their associated structures, has been the subject of much controversy and considerable speculation. The work of Legueu, Delbet, Aversenq, and their associates has aided greatly in the understanding of postoperative periprostatic inflammations. A study of perivesical and periprostatic infections entails a consideration of (1) causative agents, (2) pathway of infections, and (3) localization of inflammatory collections.

CAUSATIVE AGENTS

The etiological factors in the development of such lesions are manifold. A correct classification must necessarily include those factors of urinary and nonurinary origin but for all practical purposes may be considered under two groups: (A) exacerbation after operation of some old pre-existing lesion of the bladder, prostate, seminal vesicles, or urethra; (B) introduction of some infecting agent at the time of operation or during the postoperative course.

The influence of acute bladder infections upon the development of perivesical suppurations remains a debatable question and is particularly related to the occurrence of suppurative pericystitis in nonoperative cases following stricture or rupture of the posterior urethra, a subject with which this paper is not particularly concerned. However, Halle and Motz have shown that the infectious process in an acute bladder infection never extends into the bladder musculature or perivesical tissues by direct extension or through the lymph stream. The inference drawn from their work is that the infectious agent can reach the pericystic tissues only by taking a very circuitous route through the blood stream. Many of the recent writers disagree with this view, contending that intravesical infections do play an important rôle in the production of perivesical suppurations.

The most frequent cause of a pericystitis is chronic cystitis. It is well known that chronic cystitis is usually accompanied by a varying degree of perivesical infiltration of a chronic fibrolipomatous nature often known as chronic sclerosing pericystitis. It is possible for an acute suppuration of the loose perivesical tissues to occur during the course of a chronic cystitis. Most of the prostatic patients have some degree of residual urine with its accompanying stagnation and infection resulting in a chronic cystitis. This type of lesion is often dormant and devoid of outward manifestations but following instrumentation may flare up and lead to serious consequences. Such an infection might serve as a persistent focus of infection despite preoperative attempts to clear it up by internal medication, lavage, retention catheter, or preliminary suprapubic drainage.

In some of the old infected prostatic cases there may exist small intramural abscesses in various parts of the bladder. The inflammatory process may be the result of the infection and suppuration of the small "interrupting nodules" of lymphoid tissue found on both surfaces of the bladder. Very often the intramural abscesses are found in that portion of the bladder lying over the seminal vesicles and are due, perhaps, to an extension

of an inflammation from the latter structures. These abscesses may be present for a long time without giving rise to symptoms. Their existence in various stages of infiltration and suppuration often pass unrecognized until detected at the operating table or in the autopsy room. Such abscesses, developing insidiously, may open suddenly into the perivesical tissues at any stage of the post-operative convalescence and set up a severe perivesical cellulitis which is extremely difficult to combat and very often terminates fatally.

Other intravesical conditions, i.e., calculus, foreign body, ulcers, tumors, diverticula, and tuberculosis may be associated with a chronic cystitis and must be considered as possible etiological factors in perivesical suppurations. Tuberculosis of the bladder may be accompanied by a varying degree of pericystic infiltration which is usually of the sclerotic rather than of the suppurative type, although Caulk has noted acute suppurative pericystitis following spontaneous rupture of a tuberculous bladder. Inflammatory changes in the perivesical tissues may be associated with bladder neoplasms which frequently simulate malignant extension, and these changes may occasionally produce suppurative lesions in the pericystic tissues.

In many cases of prostatic hypertrophy a marked inflammation of the mucosa of the posterior urethra accompanies the chronic cystitis that is usually present. If the patient has been subjected to frequent attacks of retention with repeated catheterization for relief, the local condition may be aggravated and may often lead to the formation of single or multiple ulcers which serve admirably as foci of infection. The repeated instrumentation of these infected cases for relief of the urinary retention or for examination and study is always attended with the danger of causing a false passage or tear in the posterior urethral wall which provides an excellent portal of entry for the pathogenic organisms found in the bladder and urethra of these cases.

Case 5644 (Med.), D. K., white, male, aged 70 years, was admitted to the Sinai Hospital on the medical service complaining of marked dyspnœa and orthopnœa. During his stay in the hospital he developed a marked frequency, dysuria, and burning on urination, and voided in very small amounts. Because of large amounts of residual urine caused by an enlarged obstructing prostate, a retention catheter was inserted. The bladder was treated with retention catheter for 6 weeks. Cystoscopy was performed at this time by the house surgeon and a marked amount of bleeding occurred. A catheter was reinserted and the patient's temperature rose to 103 degrees. He was very toxic for several days. During the course of his treatment following cystoscopy his urine became infected and thick pus was discharged through the catheter for over 6 weeks.

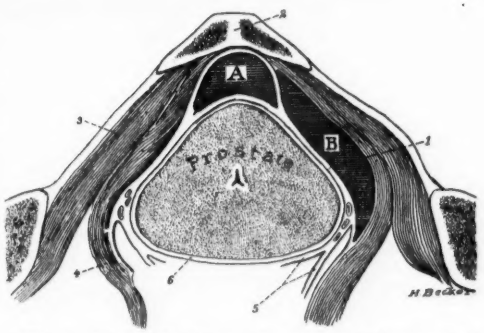

Fig. 4. Abscess in the anterior periprostatic space and in the superior pelvirectal space (after Aversenq and Dieulafe). *1*, Lateral periprostatic fascia; *2*, pubic bone; *3*, obturator internus muscle; *4*, levator ani muscle; *5*, posterior periprostatic fascia or fascia of Denonvilliers (2 layers); *6*, capsule of prostate gland; *A*, abscess in the anterior periprostatic space; and *B*, abscess in the superior pelvirectal space.

Rectal examination at this time revealed an induration along the posterior and lateral aspects of the prostate and extending up along the base of the bladder. The patient's condition gradually became worse and it was deemed advisable to cystoscope the patient again to locate, if possible, the origin of the pus. The vesical orifice was very irregular and the prostatic urethra was very markedly injected and appeared to have several lacerations on its posterior surface. Pus could be seen oozing from a pouch in the posterior wall of the prostatic urethra. Catheter was reinserted but removed in 2 days. Patient was treated with hot rectal douches and the condition gradually subsided. He began voiding and continued to do so for 18 days when he was discharged from the hospital with the advice to return for a prostatectomy at a later date. The patient was readmitted to the hospital and a perineal prostatectomy was performed 4 months later. Patient had an uneventful recovery with a perfect functional result.

This case illustrates the type of infection that may result from instrumentation of the

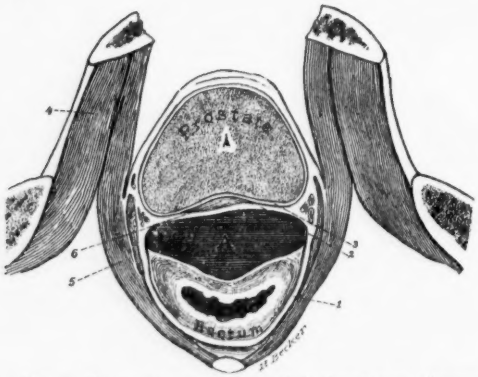

Fig. 5. Transverse section of pelvis showing an abscess of the posterior extraprostatic space, resulting from the spread of the inflammatory process through the posterior periprostatic fascia (after Aversenq and Dieulafe). *A*, Abscess in posterior extraprostatic space; *1*, fascia recti; *2*, posterior periprostatic fascia; *3*, capsule of prostate; *4*, obturator internus muscle; *5*, levator ani muscle; and *6*, posterior periprostatic space (separable space).

posterior urethra or following cystoscopic examinations. Undoubtedly, the source of infection was an infected prostatic urethra and bladder. The avenue of infection was through a tear in the posterior wall of the prostatic urethra. The infectious process must have involved the prostate gland and the posterior periprostatic space or the retroprostatic and retrovesical separable spaces. Fortunately, drainage occurred through the opening of the prostatic urethra and with the expectant treatment the condition subsided.

These old infected prostatic patients often have an accompanying seminal vesiculitis or prostatitis which may be aggravated by instrumentation. The extension of the inflammatory lesion of the posterior urethra to the prostate, seminal vesicles, vas deferens, and epididymis is undoubtedly more frequent in the catheterized group of patients than in the noncatheterized group. The opening of the different ducts in the posterior urethra can easily be infected by the passage of an instrument. Not infrequently during the removal of an enlarged prostate by the perineal route, the operator may notice an outflow of purulent fluid about the ejaculatory ducts, of either prostatic or seminal vesical origin.

An abscess of the prostate may exist within the hypertrophied prostate and may remain unrecognized until the bladder or prostate is opened to remove the suspected enlargement. The prostatic abscess may follow recent instrumentation or may be associated with stricture of the urethra, stone in the urethra or prostate, or an old gonorrhœal urethritis. The infection within the prostate may be a limited one as the infecting agent may be overcome at an early stage (catarrhal or parenchymatous involvement of the prostate) and undergo resolution. In some instances the process may continue on to abscess formation. The abscess may rupture spontaneously into the posterior urethra while at stool or following manipulation of the finger in the rectum. Occasionally the abscess may break through the prostatic capsule and invade the periprostatic spaces and set up a periprostatic cellulitis. If the inflammation is confined to the posterior periprostatic space, it may give rise to a firm mass which may be confused with an enlarged prostate.

It must be borne in mind that extravesical lesions may sometimes be the etiological factor in the production of suppuration in the perivesical and periprostatic tissues. Localized perivesical inflammations may be complications of an acute appendicitis or sigmoid diverticulitis when these organs are in close proximity to the bladder. Tuberculosis or carcinoma of the intestines may give rise to a secondary infection of the perivesical tissues. Osteomyelitis and tuberculosis of the pubic bone may occasionally be the causative agents in pericystic infections. Distant foci of infections, such as infected teeth, tonsils, respiratory tract lesions, carbuncles, and so on, may be responsible for perivesical infections reaching the latter area by way of the blood stream.

TYPES OF INFECTION

The postoperative suppurative lesions about the prostate and bladder vary in severity and chronicity and for all practical purposes may be considered as mild or severe conditions.

The mild type of suppuration occurs within a relatively short time after operation. It is essentially a localized abscess confined to the space of Retzius. This form of infection is

the result of flooding the prevesical space with infective material at the time of operation and of inadequate drainage after operation. These lesions usually respond quickly to treatment in the form of adequate drainage and irrigation of the infected area. These patients all have septic temperatures with localized signs of infection and pain. The pain is usually in the lower abdominal or bladder region. Often the movement of the hip joints increases pain and the patient prefers lying flat on the back with thighs in flexion. Constipation or diarrhœa may be present.

Occasionally if the infection is not recognized early and not treated properly, it may spread to the remaining extrafascial spaces, i.e., the prerectal and superior pelvirectal spaces, and set up a diffuse cellulitis. The inflammation may extend, in front, up to the anterior abdominal wall, or to the peritoneum of the iliac fossa, or it may involve the pubic bone; laterally, it may descend to the ischiorectal space; behind, to the perineal region below and to the lumbar region above. When the process becomes diffuse the patient usually develops a septicæmia and succumbs.

The severe type of inflammation is of insidious onset, occurring at a time when the suprapubic wound is closed or a small, clean healing fistula is present. There do not appear to be local signs of infection about the wound, yet the patient is toxic, having an elevated septic temperature often accompanied by repeated chills. He is easily fatigued. There is a loss of weight and appetite. He appears anxious and later may become prostrate if the sepsis persists.

Pain is a constant symptom in these cases. When the infection is confined to the space of Retzius, the patient complains of pain in the suprapubic or bladder region, but if the infection spreads down along the sides of the bladder the pain may be referred to the anal or perineal region depending upon the localization of the infection. Occasionally crepitation may be elicited over the suprapubic area of infection.

Bladder symptoms, such as frequency and dysuria, may be present provided the patient has already regained urinary function. Gastrointestinal symptoms are not particularly marked in the early stages of the infections but later in the course, nausea and vomiting may occur. Bowel function may become painful and is accompanied by either diarrhœa or constipation, especially if the infection has spread to the retrovesical and retroprostatic planes.

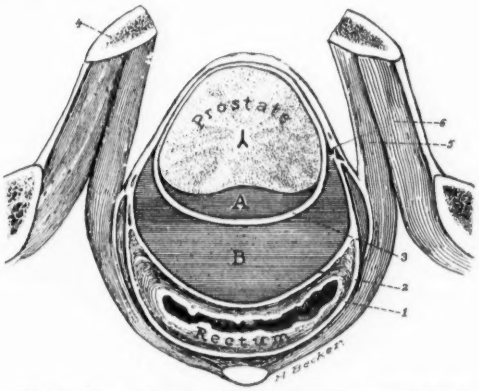

Fig. 6. Abscess in posterior periprostatic space and subcapsular abscess (after Aversenq and Dieulafe). *1*, Fascia recti; *2*, posterior periprostatic fascia (or fascia of Denonvilliers) (2 layers); *3*, capsule of prostate; *4*, inferior ramus of pubic bone; *5*, obturator internus muscle; *6*, levator ani muscle; *A*, subcapsular abscess; and *B*, posterior periprostatic abscess.

This type of infection usually leads to a septicæmia with a fatal ending. The underlying cause is a hidden abscess developing slowly about the prostate and base of the bladder and often not palpable on rectal examination. After some time the infection may eventually appear around the suprapubic wound but is difficult to diagnose because of the lack of local signs.

The presence of a tumor mass in the suprapubic region which simulates a distended bladder and is fluctuant on palpation and painful on motion of the body is a diagnostic objective sign. The diagnosis may be confirmed by passing a catheter into the bladder and noting that the mass does not subside after all the urine is withdrawn from the bladder. The surgeon should always perform a rectal examination in these cases to detect the presence of a fluctuating and tender mass about the bladder and prostate. The infection may appear at some distant focus,

i.e., in the inguinal canal, in the groin, on either side of the perineum, among the muscles of the thigh, or in the pelvis. When the abscess points in any of these superficial places and is incised and drained, instead of complete recovery, there is a temporary alleviation of symptoms with the formation of other new collections at different places. As long as the original focus of infection about the prostatic bed remains unrecognized and untreated, the resistance of the patient is overcome, he develops a septicæmia, and succumbs.

THE PATHWAY OF INFECTION

The propagation and extension of localized lesions into the tissues surrounding the operative field has been the subject of considerable controversy and of little investigation. Three possible routes may be considered: (1) direct extension by cellular infiltration, (2) lymphatics, (3) blood stream.

Direct extension. This route serves to explain a large number of prevesical inflammations occurring within a relatively short time after a suprapubic bladder operation. Such infections are confined to the space of Retzius and are practically always accompanied by a delayed closure of the suprapubic wound and the formation of a persistent suprapubic fistula. This type of infection is due to a flooding of this region with infected urine at the time of operation or inadequate drainage of this area and the bladder after operation.

The relation of drainage to prevesical inflammations is worthy of more than passing comment. The insertions of gauze drains or rubber tubes into the space of Retzius and into the bladder following suprapubic operations tends to prevent accumulations of infective material in the deep pocket created behind the pubic bone. In all such cases, drainage takes place in an upward direction, and in some instances might prove to be insufficient, with the result that there is a gradual accumulation of infected urine behind the pubic bone. The prolonged stasis of this urine may lead to inflammatory lesions varying from a mild suppuration to extensive abscess formation with necrosis and gangrene of the tissues involved.

Fortunately for the patient most of the infections in this area are recognized early and respond quickly to proper drainage and irrigation. Occasionally the infection is a virulent one and the infiltration progresses rapidly and spreads insidiously into the cellular planes about the base of the bladder. It may pass upward and point under the skin of the inguinal region or pass down to the iliac fossæ. It may attack the posterior surface of the pubic bone setting up a periosteitis and later burrow under the adductor muscles on the inner aspect of the thigh.

There is a very small group of cases in which infection of the periprostatic and perivesical areas occurs at some time after operation. In this type of case, the suprapubic wound heals well but a localized abscess is found at some distant point such as the inguinal or iliac regions or in the abdominal walls. The primary focus of infection is a slow growing abscess of the prostate or bladder wall which opens into the fascial planes around the prostate and base of the bladder during the patient's postoperative convalescence. Such a small abscess is often encountered at operation and heals spontaneously but more frequently remains unrecognized. These small abscesses are found on the sides or the base of the prostate or on the lower portion of the posterior bladder wall and are beyond the reach of the finger in the rectum. Unfortunately, there appears to be no connection between the prostate or bladder and the localized abscess in the abdominal or inguinal regions. Incision and drainage of localized abscess give temporary relief but as the original focus in the prostate and bladder wall remains unsuspected the old abscess persists or new ones develop. The patient gradually succumbs to a long drawn out infection.

Lymphatic route (Figs. 8 and 9). The rôle of the lymphatics in the propagation of inflammations about the prostate and bladder following operations is most important. The lymphatic drainage of these areas has been rather clearly worked out and demonstrates a closely related distribution and ultimate destination which in all probability determines the direction of these infections.

The lymphatic system of the bulbous and membranous urethra is essentially made up of 3 groups of afferent vessels. One afferent trunk is found on the upper surface of the bulb usually in the angle between the corpora cavernosa and follows the course of the artery of the bulb and later the internal pudic artery to enter the deep layers of the pelvis and drain into the hypogastric glands. A second afferent trunk passes behind the symphysis pubis to drain into the retrocrural gland. A third trunk passes up on the anterior surface of the bladder, unites with the lymphatics draining the inferior portion of the bladder, and enters the middle gland of the internal chain of external iliac glands.

The lymphatics of the prostatic urethra unite with collecting trunks that drain the prostate gland. The lymphatic channels about the posterior urethra and the vesical orifices are especially wide and easily discernible in microscopical sections.

The lymphatics of the prostate are quite numerous. They begin as a fine capillary network surrounding the acini of the gland. From this periacinous network larger vessels pass to the periphery of the gland to form a periprostatic network. It is from this latter network found on each of the four surfaces of the gland that symmetrical collecting trunks arise.

A large trunk from the posterior surface of the gland passes upward on the bladder in the triangle between the two vasa deferentia as far as the middle part of postero superior surface of the bladder. At this level it makes a sharp curve outward, crossing the hypogastric artery to end in the middle gland of the internal chain of the external iliac group. As the lymphatics run along the posterior surface of the bladder they pass through some small interrupting nodules.

Another collecting trunk from the posterior surface of the gland accompanies the internal pudenal artery and passes in an upward, outward, and backward direction to terminate in the middle gland of the hypogastric group.

Two or three afferent trunks arise on the posterior and lateral surfaces of the gland and pass downward and backward in the sacro-

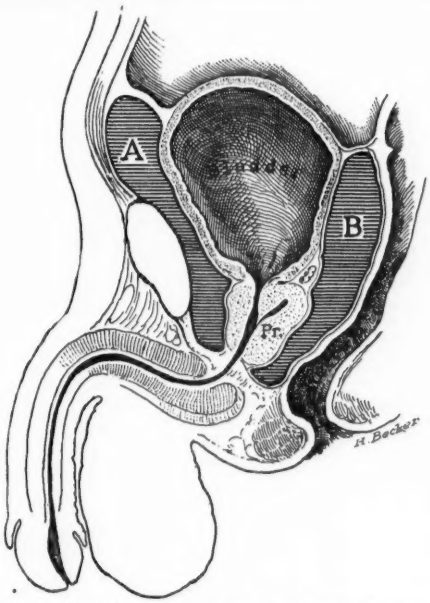

Fig. 7. Drawing representing the two most common sites for the localization of pus about the bladder and prostate (after Culver and Baker). *A*, Abscess in the prevesical space (space of Retzius), and *B*, abscess in the retrovesical separable space (posterior periprostatic space).

genital fold. They cross the lateral surface of the rectum to end in the lateral sacral gland and those glands along the sacrum as high up as the promontory.

Collecting trunks from the anterior surface pass down to the deep pelvic fascia to unite with collecting trunks from the membranous urethra and pass along the course of the internal pudic vessels to terminate in the hypogastric group of lymph glands.

The lymphatics of the bladder are found in the muscularis and in the submucosa. The mucosa of the bladder is entirely devoid of lymphatics. The network found in the muscularis is well developed and gives off branches which pass to the external surface of the bladder and form a second network of lymph vessels. The afferent trunks from the peripheral network take different courses depending upon their situation on the anterior or posterior surface of the bladder.

The anterior surface has two groups of collecting trunks corresponding to the inferior and superior segments of the bladder.

In the inferior group the vessels run in an outward direction to drain into one or more glands of the external iliac group on the lateral surface of the pelvis between the obturator nerve and the external iliac vein.

In the superior group the lymphatic trunks from the upper segment of the bladder take an upward and outward course and after crossing the hypogastric arteries terminate in the middle chain of the external iliac group.

One posterior surface has several groups of collecting trunks. The afferent vessels from the superior portion unite with those of upper segments of the anterior surface and enter the external iliac group. Other collecting trunks from the posterior surface pass in a backward direction to terminate in the external iliac glands situated near bifurcation of the common iliac artery. The afferent lymphatics from the middle portion of the posterior surface end in the hypogastric group. The lymphatics from the inferior segment and vesical neck pass directly backward over the lateral surface of the rectum and then upward over the sacrum to end in the glands as high up as the sacral promontory.

As the afferent lymphatics pass over the anterior and posterior surfaces of the bladder, their course is interrupted by small nodules of lymphoid tissue or secondary glands which are called "interrupting nodules" and correspond to *shalldruesen* of the Germans. These small nodules play an important part in the formation of intramural abscesses as they may easily become inflamed and if suppuration ensues may lead to a perivesical infection.

In the region of the neck of the bladder there is a rich anastomosis of the lymphatics of the vas deferens with those of the prostate, posterior urethra, and bladder. About the base of the bladder, the lymphatics of the bladder become continuous with those of the seminal vesicles and lower part of ureter.

The lymphatics of the seminal vesicles are found in the submucosa and muscularis and drain into the hypogastric lymph nodes.

The ureter has an abundant network of lymphatics in its muscularis and external fibrous sheath. However, the lymphatic drainage of the ureter varies with the different parts. The efferent trunks of the lower third join with those of the bladder and urethra to drain into the hypogastric nodes. From the middle third of the ureter the efferent lymphatics terminate in the lumbar nodes situated along the vena cava and aorta just above the bifurcation. The lymphatics of the upper third of the ureter join with those of the kidney and enter the group of aortic lymph nodes above and below the level of the renal vessels. The lymphatics of the ureter anastomose with those of the bladder and kidney.

The lymphatics of the kidney are rather abundant and intimately surround the tubules and glomeruli. In addition, there is also a subcapsular network. There is an intimate anastomosis between these two groups. The drainage of the kidney is through the lymphatics of the hilum of the kidney into the aortic nodes about the level of the renal vessels and through the lymphatics of the kidney capsule to the lumbar nodes. The lymphatics of the kidney capsule join with those of the fatty capsule.

In brief, then, there is a close relation between the lymphatic supply of the genito-urinary system, as evidenced by the intercommunication between the efferent lymphatics of the prostate, seminal vesicles, urethra, and bladder, and that of the ureter, pelvis, and kidneys. There is no anastomosis between the lymphatics of the genito-urinary organs and the rectum, as the latter is a part of an extensive lymphatic system of the intestinal tract.

The development of perivesical and periprostatic infections after operation in most instances is dependent upon a septic lymphangitis. These infections are prone to occur in old infected prostatic cases in which the prostatic urethra, prostate, and bladder walls are the sites of a chronic inflammatory process as the result of long standing retention of urine and repeated instrumentation. This inflammatory process may be superficial or deep and may be associated with small ulcers or abscesses. Although the operation (suprapubic cystotomy or prostatectomy) relieves the patient of retention and reduces the dangers of

generalized infections, it does not prevent the development of infection in the prostatic urethra or bladder which may spread to the surrounding areas by way of the lymphatics. The infection may be carried by the lymphatics to some distant point (iliac, lumbar, kidney, or hypogastric regions) and there set up an extensive suppurative process which is difficult to combat.

The propagation of infection by the lymphatic route serves to explain the development of postoperative suppurations in cases in which there is no history of instrumentation or manipulation following operation. In cases of suprapubic prostatectomy the prostatic bed is poorly drained and may act as fertile soil for pathogenic organisms and thus provide a focus of infection which may spread rapidly by way of the lymphatics.

Blood stream. Although there is frequent anastamosis between the blood vessels of the various genito-urinary organs and a common source of blood supply for the rectum and some of the genito-urinary organs, there is no clinical evidence to show that infection can be carried from one part of the urogenital tract to another by direct vascular connections. It is a well known fact that there are blood channels extending from the bladder to the kidney, yet none of the blood from the bladder goes to the kidney before entering the vena cava. It is possible, however, for a focus of infection in one part of the tract to set up a general blood stream infection and cause a secondary hæmatogenous infection to another part of the tract.

The rôle of thrombosis or thrombophlebitis in the extension of infections about the prostate is perhaps of more theoretical than actual interest. It is interesting to note that Englisch has reported a series of so called idiopathic cases of perivesical inflammation, in which the infectious agent was carried to the perivesical region from some distant focus. Culver and Baker likewise suggest a similar explanation for 2 cases of their series.

THE RELATION OF THE OPERATIVE PROCEDURE TO INFECTION

The nature of the infection introduced at or following operation varies with the type of operation performed. The occurrence of a severe infection in the prevesical region following a suprapubic cystotomy or prostatectomy is primarily due to a flooding of the operating field with septic urine. Opening a bladder which is distended with urine or which has been filled with some fluid before operation increases the danger of infection about the base of the bladder.

It is surprising to note that little or no mention is made in the literature of such local complications despite the immense number of cystotomies that have been performed. The fact that these cases are not reported is not a true indication of their rarity but rather represents a reluctance on the part of the surgeon to record a poor result. However, the recent refinements of operating technique and the careful preoperative preparation of the patient may be responsible for the relative infrequent occurrence of such unfavorable complications.

Legueu and Rochet have observed 3 cases of periprostatic and perivesical cellulitis in a series of more than 1,000 suprapubic prostatectomies. Chute has reported 6 cases of perivesical suppuration in which the etiological factor was quite clear. In 1 case, the infection followed a suprapubic cystotomy (for benign hypertrophy of the prostate) in which the prevesical space was infected and inadequately drained. In the other 5 cases the infection followed traumatism of the posterior urethra. Culver and Baker report a series of 7 cases of perivesical suppurations in which one case developed a suppurative lesion completely circumscribing the bladder about 2 weeks after a second stage suprapubic prostatectomy. Of the 6 other cases, 1 was the result of an extension from infected seminal vesicles; 1 from a suppurative cystitis; 2 following surgical trauma to an infected posterior urethra; and in 2 cases the etiological factor was undetermined but was probably the result of a blood stream or lymphatic extension from an infected bladder or posterior urethra. Moschcowitz (quoted by Caulk) reports a case of perivesical suppuration following trocar aspiration for preliminary suprapubic drainage.

The likelihood of a cellulitis developing after a suprapubic prostatectomy appears to

be greater than after a simple cystotomy. The former procedure requires a good exposure of the operative field, a larger incision of bladder, and difficult and often traumatizing manipulations to remove the prostatic growth. Another very likely source of danger and focus of infection in the prostatectomized patient is the dead space created by the removal of the enlarged gland. This space is constantly filled with stagnant and infected urine and when poorly drained provides an excellent nidus for the growth of pathogenic organisms.

The danger of periprostatic or perivesical infection following a perineal prostatectomy appears to be more theoretical than actual, as Young in his extensive series has never had such a complication and, likewise, a review of the literature fails to reveal any cases. The reason for the rare occurrence of these complications is quite obvious. In a perineal prostatectomy, adequate drainage is provided. The gauze pack in the prostatic bed and the bladder drain prevent accumulations of septic urine about this area during the first 48 hours after operation. It is during this early period, before a natural barrier to infection in the operative area can be set up, that extravasated urine or flood of pathogenic organisms from the bladder and posterior urethra can gain entrance to the loose cellular planes about the prostate and bladder.

Perivesical infections may occur after partial cystectomies for malignant tumors or inflammatory lesions of the bladder, total cystectomies, operations for diverticuli of the bladder, or operations upon the seminal vesicles. The mechanism is essentially the same as after suprapubic cystotomy or prostatectomy. In partial or complete excision of the bladder, the floor or base of the bladder is usually involved, and there is an accumulation of urine in the operative area with organisms entering the cellular planes to set up a diffuse cellulitis.

Periprostatic or perivesical suppurations may also develop after any of the following procedures: instrumentation of the urethra, operations upon the urethra, endoscopic or cystoscopic examinations, insertion of retention catheters into the bladder, punch or cutting operations at the vesical neck, and operations for prostatic abscess with incomplete drainage.

When properly sought for, these diffuse infections will explain many of the prolonged septic temperatures that occur after any of the above procedures.

LOCALIZATION OF INFLAMMATORY PROCESS

The sites of predilection for localized suppurations following operations on the bladder and prostate are dependent upon the origin of infection and its avenue and manner of spreading. The localization of suppurations around the prostate is closely linked to the anatomical relationship of the prostate and its surrounding cellular spaces.

However, a review of the literature on perivesical infections reveals a marked tendency to use interchangeably and often incorrectly the terms suppurative pericystitis, suppuration of the perivesical space, abscess or phlegmon of the space of Retzius. The terms perivesical and periprostatic suppuration infer the accumulation of pus intimately surrounding or adjacent to the bladder or prostate and confined within the various spaces about these organs by the fascial sheaths.

The type of micro-organisms usually found in perivesical and periprostatic infections are anaerobes, i.e., staphylylococcus, streptococcus, and colon bacillus. These organisms are very likely to be found in the infected bladder and posterior urethra and hence may be carried to the pericystic tissues by the blood or lymph channels or directly implanted during or after operation.

These inflammatory collections about the prostate and the base of the bladder are essentially of three types:

1. Intrafascial. Occurring in any one of the various spaces situated between the true prostatic capsule and the different periprostatic fascias.

2. Extrafascial. Occurring in the spaces external to the periprostatic fascial planes.

3. Distant suppurations. The result of extensions of the inflammatory process by way of the blood stream, lymphatics, or by direct continuity from the focus of infection in the operative area.

The nature of these infections varies from a localized abscess confined within the fascial spaces about the prostate and bladder to a diffuse cellulitis in the extrafascial planes. The latter group are essentially phlegmons which may spread to distant regions (kidney, groin, thigh, or perineum) and point more or less to an abscess.

In this respect, it is interesting to note the results of Aversenq and Dieulafe in an experimental and anatomical study of prostatic abscess. By means of forced injection of colored gelatin they demonstrated the integrity of each of the periprostatic spaces from the standpoint of possible localization of pathological collections following prostatic abscess. Experimentally they were able to create three types of collections: subcapsular (within substance of prostate gland), posterior periprostatic, and prerectal (Figs. 2, 4, 5, and 6).

They noted that subcapsular collections had a tendency to limit themselves but could easily spread into the posterior periprostatic space. They found that collections confined within the posterior periprostatic space could extend up between the seminal vesicles reaching the peritoneal cul-de-sac and down to the apex of the prostate and the external vesical sphincter. Injections within the prerectal space easily fill the entire bed extending down to the triangular ligament. It was extremely difficult to produce a distention of the lateral periprostatic spaces by the injection. When the anterior periprostatic space was injected the injection mass passed upward into the space of Retzius and even spread into the superior pelvirectal space. However, it must be borne in mind that their study was primarily concerned with the spread of infection by continuity rather than by the lymphatics or blood stream.

The localization of infective processes following suprapubic operations is quite similar to that which follows the extension of a prostatic abscess, especially when the infection spreads in the fascial planes about the posterior surface of the prostate and bladder. However, the greatest number of local complications following operation are seen in the immediate operative field due primarily to a flooding of this area with septic urine.

A. Intrafascial infections. The development of an inflammatory lesion in the anterior periprostatic space (Fig. 4) is relatively rare following operation due to the fact that the anterior lobe of the prostate is seldom the seat of a pre-operative or postoperative infection. Many years ago Guyon pointed out that from a surgical standpoint there is no prostate in front of the urethra. An abscess in this region may easily be overlooked as it is out of reach of the examining finger in the rectum. Not infrequently, however, an infection beginning in the space of Retzius may spread down into this region. The extension of an inflammatory process from the posterior urethra and prostate to the anterior periprostatic space, brought about by a thrombophlebitic process involving the plexus of Santorini, is possible but not probable.

The lateral periprostatic space area is seldom, if ever, the site of a localized inflammatory lesion before or after operation. The rarity of infection in this region is contrary to expectation in view of the great number of blood vessels and lymphatics which are found traversing the thin connective tissue of the space. It may be that infections occur in this space and are not diagnosed until they spread into other fascial planes. When infection does occur in this space it is usually due to direct extension of the inflammatory process from the retroprostatic and retrovesical planes. In rare instances, pathogenic organisms may be carried to this area by way of the blood stream or lymphatics and set up a localized abscess which spreads rapidly to the other fascial planes about the prostate. True lateral periprostatic infections are extremely difficult to recognize by rectal examination, but when extension to other areas, particularly the posterior periprostatic space, occurs, the presence of a palpable mass over the posterior surface of the prostate renders the diagnosis easy.

The posterior periprostatic space is frequently the site of an unsuspected abscess following suprapubic prostatectomy. The dead space created by the removal of the prostatic growth provides an excellent medium for the accumulation of virulent bacteria which may spread into posterior fascial

planes by direct extension. The trauma incidental to the suprapubic removal of a prostatic enlargement renders the capsule of the prostate vulnerable to infectious processes. Suppurations beginning in other periprostatic planes may easily extend to this space as aforementioned.

From an anatomical standpoint, the posterior periprostatic space may be divided into a retroprostatic and retrovesical area. The retroprostatic area is the *decollable espace*—the distensible or separable space of the French writers. This space lies between the capsule of the prostate and the fascia of Denonvilliers and should not be confused with a presumably potential space existing between the two layers of the fascia of Denonvilliers. In the loose cellular confines of this separable space, collections of pus may readily gather and then break through the fascia of Denonvillier to reach the prerectal space. The retrovesical area is more compact and is less frequently the site of an inflammatory lesion. However, this portion may be the seat of a chronic insidious abscess as a result of an abscess of the wall of the bladder or of the seminal vesicles opening into this space. An inflammatory lesion in the retroprostatic area may spread up into the retrovesical area, but as a rule does not spread beyond the seminal vesicles which act as a barrier.

Abscesses developing in the posterior periprostatic space may spread in a transverse plane around to the anterior and external surfaces of the prostate or in a vertical plane to reach the region of the seminal vesicles upon the base of the bladder or up to the peritoneal fold. The fascia of Denonvilliers serves as a solid barrier limiting the infection within the posterior periprostatic spaces. However, the fascia of Denonvilliers is not uniformly thick and in some regions is a thin cellular aponeurosis which permits infectious organisms to break through and reach the prerectal space.

The nature of the inflammatory lesion in the posterior periprostatic space may vary from a diffuse cellulitis to frank abscess formation and may readily perforate the fascia of Denonvilliers to invade the prerectal space. A cellulitis within the posterior periprostatic space is essentially a periprostatitis and should be differentiated from an inflammatory lesion of the prerectal space.

B. Extrafascial infections. 1. Suppuration within the anterior extraprostatic space (more commonly known as the space of Retzius) (Fig. 7) is the most frequent local complication following operations on the bladder and prostate by the suprapubic route. Suppuration within this space should properly be called an abscess or phlegmon of the space of Retzius and should be differentiated from suppurative pericystitis, which is an infection covering all sides of the bladder in which an accumulation of pus is anatomically possible. Suppurative pericystitis is most frequently the result of a prevesical space infection which has spread to the retrovesical separable space and involves the entire external surface of the bladder with the exception of a small area on its anterosuperior surface surrounding the attachment of the urachus and the obliterated hypogastric arteries.

In reviewing the literature one is impressed with the striking relation of suppurations of the prevesical space to trauma incidental to operations or instrumentation in cases of stricture of the urethra, whereas but scant reference is made to the development of similar infections following operative procedures upon the urogenital organs. It is interesting to note that frequently a diagnosis of suppurative pericystitis is made in preference to an abscess of the space of Retzius, although the infection usually starts in the latter area as a result of intra-urethral and peri-urethral inflammations spreading through the lymph channels and glands found in this area. The diagnosis of suppurative pericystitis is based upon the occurrence of a mass in the loose perivesical tissue behind the umbilicoperivesical aponeurosis (posterior layer of the transversalis fascia).

The actual infection in the space of Retzius in this case may be slight but there may be an extensive collection of pus on all sides of the bladder especially in the retrovesical region. Infections in this region are primarily

due to a flooding of the operative field with septic urine. The accumulation of infected urine behind the pubic bone eventually causes suppuration and necrosis of the cellular tissue of this space and may even attack the bone itself. Inflammatory lesions within the bladder or prostate or their adjoining spaces may readily extend to this region either by direct extension or by way of the vascular or lymph channels stream. Following perineal prostatectomy the occurrence of an infection in the space of Retzius is extremely rare and would undoubtedly be carried there by the lymphatics or blood stream.

Case 56. E. G., white, male, aged 64 years. Seven days after admission, one stage suprapubic prostatectomy had been performed. A rubber tube was inserted in the bladder and a gauze drain was placed in the space of Retzius. This drain was removed in 3 days. Seventeen days after operation a large abscess developed in the space of Retzius which was more marked to the left of the midline. The abscess was opened and drained. The patient voided through the urethra on the seventeenth postoperative day. Thirty days after operation the original incision was opened wide and adequate drainage established. The patient was discharged from the hospital 57 days after operation with the abdominal wound completely healed and he was voiding entirely through the urethra with good control.

This case illustrates the common type of infection which occurs in the space of Retzius following a suprapubic bladder operation. The infection is the result of infected urine seeping into the prevesical tissues or flooding of the operative field with infected urine at the time of operation. The condition responded well to immediate treatment such as wide incision and adequate drainage.

Case 6792. I. H., white, male, aged 83 years, was admitted to Sinai Hospital complaining of a swelling over the suprapubic region. The swelling appeared 4 days prior to admission. It was accompanied by a marked frequency of urination, urgency, and unbearable burning on urination. A suprapubic prostatectomy had been performed 4 years prior to this admission. At the time of the first operation there was delayed healing of the suprapubic wound with a persistent suprapubic urinary fistula. Following his discharge from the hospital he complained of urinary discomfort for a long time. On examination at the time of this admission, the essential findings were (1) that his urine contained a great deal of pus; and (2) that an indurated mass measuring 5 by 8 centimeters was present in the suprapubic region. The mass was exquisitely tender on pressure. Patient was very toxic.

A provisional diagnosis was made of a suprapubic abscess resulting from an extravasation of urine. This was incised the following day and thorough drainage of the space of Retzius was established. The abscess was confined to the space of Retzius. There were no pockets leading down alongside of the bladder or prostate posteriorly. Patient died 48 hours after operation. No autopsy was obtained.

This case represents a rather unusual condition in that the abscess developed 4 years after the original operation. Undoubtedly the infection in this case was the result of a very slow extravasation of urine through the old urinary fistulous tract. The delayed healing of the suprapubic wound and the persistent suprapubic urinary fistula were the primary etiological factors in the development of this abscess in the space of Retzius. As far as could be determined by rectal examination and findings at the operating table there was no involvement of the lateral or posterior surface of the bladder or prostate. The persistent suprapubic urinary fistula, after the first operation, may have been due to an obstruction at the vesical neck following the prostatectomy, but inasmuch as the patient failed to return for examination following the operation this condition could not be ruled out.

Inadequate drainage of the space of Retzius following suprapubic operations predisposes to the collection of stagnant urine in this area, and often in spite of good drainage of this area septic urine will accumulate due to the uphill direction of the drainage. Fortunately inflammatory lesions in this space are readily recognized and respond well to treatment.

Occasionally the infectious process is a virulent one and may attack the posterior surface of the pubic bone denuding the periosteum and setting up a true osteitis. Beer believes that the infection of the periosteum is most frequently the result of injury to the periosteum by traction on the attached muscles but occasionally may be due to direct bruising of the periosteum by drainage tubes.

The erosion of the bone is often visible roentgenographically in the advanced stages

and must be differentiated from carcinomatous metastases. Clinically the bone lesion is diagnosed because of pain on movement of the pelvis and tenderness upon pressure over the affected region. Often the infectious process may infiltrate the muscles of the thigh passing under the adductor group or attacking their attachments to the pubic bone. Such cases present symptoms of an arthritis of the symphysis pubis. The patient assumes an attitude of slight flexion and adduction of the thigh. Pressure upon the pubic bone or the inferior rami of the pubis or the muscles in front of or below the bone is extremely painful. The patient restricts his movements, as any motion of the legs, thighs, or pelvis is painful. This condition is frequently accompanied by general symptoms and often leads to septicæmia.

The condition is a rare complication. Beer states that he has seen 1 or more cases every year during the period between 1916–1928. We have seen 4 such cases which fortunately recovered following curettement, adequate drainage, and external heat or diathermy. In cases of prolonged infection behind the pubic bone with protracted infiltration of the muscles attached to the pubis, degenerative changes within the muscular components such as atrophy or calcification may be noted, presenting in rare instances a picture simulating myositis ossificans.

Case 485. H. T., white, male, aged 64 years. A one stage suprapubic prostatectomy was performed on this patient 19 days after admission to the hospital, during which time he was drained with a retention catheter in his bladder. At the time of operation the space of Retzius was drained with iodoform gauze. Seven days after operation the wound showed evidence of necrosis. Culture from the wound revealed bacillus coli communis. There was delayed healing of the suprapubic wound. Attempts to hasten closure of the wound were tried by the following methods: curettement, external application of heat to the wound, and insertion of a retention catheter into the bladder to keep the urine away from the wound. Urinary drainage from the wound persisted for 51 days. Patient was discharged from hospital in good condition with wound closed.

He was readmitted to the hospital 37 days after his discharge, complaining of an intense pain in the suprapubic region. The slightest movement of the pelvis or legs was extremely painful. There was marked tenderness along the symphysis pubis and the inferior rami of the pubis. An X-ray picture at this time revealed small areas of bone destruction over the pubic bone on the right close to the symphysis, suggesting an osteitis or osteomyelitis (Fig. 10). The suprapubic wound was curetted on several occasions, penetration being made as deep as possible while the bone was being curetted. The lower end of the incision was reopened and drained. Hot applications, Alpine lights, and massage were also employed. Diathermy was used every day for 8 days. These treatments were continued for a period of 2 months when the condition finally subsided and the wound was closed. Patient has been well ever since his discharge from the hospital.

This case illustrates the type of infection that may occur following a suprapubic prostatectomy. The infection originally started in the space of Retzius and then, progressing downward, involved the posterior surface of the pubic bone, setting up an osteitis of this bone, a rather uncommon sequela which was clearly demonstrated by a roentgenogram. The original source of infection was probably the infected urine draining from the bladder which seeped down to the tissues and set up an inflammatory process in the space of Retzius. This case showed typical signs of arthritis of the symphysis with involvement of the adductor muscles of the thighs. The postoperative course in such cases is protracted and response to treatment is slow. External applications of heat to the suprapubic region, diathermy, Alpine light therapy, and curettement of the infected area and the bone offer the best results.

Case 2732. H. W. R., white, male, aged 58 years. A suprapubic cystotomy and a bilateral resection of the vas deferens was performed 19 days after admission to the hospital during which time the patient's bladder was drained with a retention catheter. The urine was infected at the time of operation. The space of Retzius was drained for 3 days with a loose iodoform gauze drain. The bladder was drained with a suprapubic tube placed high up in the bladder incision. Twenty-seven days after preliminary drainage a second stage suprapubic prostatectomy was performed. The space of Retzius was opened during this operation and drained with iodoform gauze for 3 days. The prostatic bed was packed with iodoform gauze. A moderate amount of bleeding was encountered at operation. No tube was inserted into the bladder. All drains were removed 3 days after operation. Beginning 6 days after the removal of all drains and for 10 days thereafter, the patient complained of pain along the

inner aspect of the right thigh, and also in the right inguinal region. The upper end of the cut vas deferens on the right was indurated and tender. At this time it was felt that the patient had a right vasitis. Hot compresses were applied to the affected part. The urinary drainage from the suprapubic wound ceased after 26 days, but a seropurulent discharge continued from the wound. At this time (the twenty-sixth postoperative day) tenderness was present over the symphysis pubis and the patient complained of pain on moving the thighs. The wound was curetted down to the posterior surface of the pubic bone. The patient was confined to his bed and received constant hot compresses with numerous curettements for a period of 55 days. Subsequent to this time the suprapubic wound finally closed, 108 days after his prostatectomy. Fourteen days after the closure of the wound (the one hundred and twenty-second postoperative day) a fluctuating mass was felt over the symphysis pubis. Aspiration revealed free pus. An incision was made and this area was drained for 26 days, a permanent closure finally resulting with no residual tenderness or swelling in the suprapubic region.

This is another uncommon type of case in which the injection did not remain localized in the space of Retzius but involved the posterior surface of the pubis giving rise to a severe peri-osteitis with some involvement of the adductor muscles. This occurred despite the necessary precautions taken at the operating table, namely: thorough drainage of the space of Retzius, loose closure of the abdominal wound, and placing of a suprapubic tube high in the bladder incision. The development of an abscess in this region is undoubtedly the result either of the flooding of the operative field with infected urine or of a persistent leakage of urine into the loose cellular spaces anterior to the bladder following the operation. The patient presented typical signs and symptoms of an arthritis of the symphysis pubis, such as pain on moving of the legs, tenderness on pressure over the pubic bone, and flexion and adduction of the legs while in bed. The response to energetic treatment was slow, but adequate drainage of the space of Retzius after thorough curettement of the infected area resulted in a permanent closure of the suprapubic wound.

Case 2465. J. M., white, male, aged 57 years. Suprapubic cystotomy was performed 4 days after admittance to the hospital. This was done early because the catheter drained poorly, and the patient began to run a septic temperature. At the time of operation a drain was placed in the space of Retzius and a tube was placed in the bladder. Fourteen days after this, while the condition of the patient was improved, the wound broke down. Nineteen days after the first date the prostate was removed. The space of Retzius was drained and the prostatic bed packed with gauze drains. All drains were removed 4 days after the operation. Three weeks after the second operation the patient began voiding through the urethra. A purulent discharge was draining from the suprapubic wound. Two months after the prostate was removed a left epididymitis developed for which an epididymectomy was performed. The suprapubic wound discharged pus continuously for 3 months and the patient presented signs and symptoms of an osteitis of the pubic bone. Finally, one hundred days after the second stage prostatectomy, the wound healed completely.

This is the third case in this series in which the infection spread from the space of Retzius to the pubic bone giving rise to an osteitis and involving the adductor muscles. This patient presented the same symptoms as the two other cases described above. It was only after thorough curettement of the pubic bone that the wound closed, removing a disability which lasted more than 4 months from the time of operation.

Occasionally an infectious process in the space of Retzius responds poorly to treatment or is neglected and there develop hypogastric or iliopelvic infiltrations. The inflammatory process may spread on each side to the iliac fossa or the inguinal canals, or down to the pelvic walls to enter the obturator canal and to extend under the adductors of the thighs, or down to the base of the bladder or prostate.

2. The lateral extraprostatic space (Fig. 4) is commonly described as the superior pelvirectal space and corresponds to the whole lateral surface of the prostate. This space is seldom the site of a primary postoperative infection. However, it frequently represents the fusion place of suppurations extending from the space of Retzius, the anterior or posterior periprostatic spaces. In rare instances small abscesses of the lateral lobes of the prostate, the base of the bladder, or the seminal vesicles may open directly into this space.

Suppurations within the superior pelvirectal space are prone to occur before opera-

tion, developing during the course of preliminary drainage of the bladder by a retention catheter. An infected posterior urethra or prostate may easily be a source of infection and reach the superior pelvirectal space through the lymphatics. The interrelation of genital infections and concealed pelvirectal suppuration has recently been stressed by Morrisey.

The diagnosis of suppuration within this space is confirmed by a palpable mass involving the lateral and superior surfaces of the prostate and frequently covering the posterior surface of prostate and seminal vesicles. The infection within this space may extend downward and break through the levator ani muscles to enter the ischiorectal fossa.

3. Suppurations within the posterior extraprostatic space (prerectal space) (Fig. 5) are of frequent occurrence before or after operation due to the tendency of the suppurations of the prostate and seminal vesicles to spread posteriorly into the posterior periprostatic space and thence pierce the fascia of Denonvillier to reach the prerectal space. Retroprostatic and retrovesical suppurations naturally tend to open into the rectum and effect a clinical cure, but in some instances the drainage through the rectum is insufficient and the suppuration extends along and around the rectum to point as an ischiorectal abscess or to spread upward under the peritoneum forming a retroperitoneal suppuration.

C. Distant suppurations. Anteriorly, infections within the space of Retzius may extend up along the abdominal wall traversing the cellular planes above or below the recti muscles. These infiltrations and suppurations may spread over the entire abdominal wall involving the hypogastric, the inguinal, or the lumbar regions but fortunately they are amenable to treatment.

Laterally suppurative lesions about the prostate bed or posterior urethra develop as the result of infection in the dead space created by the removal of the prostatic enlargement. The infection spreads to the superior pelvirectal space and thence into loose subperitoneal space extending in all directions. It may diffuse toward the inguinal or sacral canal, iliac fossa, and lumbar regions.

Occasionally a diffuse cellulitis originating in the space of Retzius may descend along the wall of the pelvis to reach the fascial planes about the prostatic bed. From this region they may pass out of the pelvis through the sciatic or obturator openings to reach the perineum or thigh. This type of complication has an extremely grave prognosis as the inflammatory process is diffuse and extensive and practically always ends in a septicæmia.

As previously mentioned, suppurations in the superior pelvirectal space may descend and break through the levator ani muscles to the ischiorectal space.

Posteriorly, suppurations within the periprostatic space may extend up to the retrovesical region and continue in an upward or lateral direction under the peritoneum. The inflammatory process may pierce the peritoneum and set up a true pelvic peritonitis. Retroprostatic and retrovesical suppurations may become walled off and traverse the prerectal space to empty into the rectum. It is the natural tendency for prerectal suppurations to perforate the rectal wall and effect spontaneous cure by drainage through the rectal cavity. However, on occasion, a prerectal suppuration may burrow around the rectum and descend down into the ischiorectal fossa or spread up under the peritoneal coverings of rectum following the line of least resistance.

In most of the foregoing types of postoperative infection, the propagation of the inflammatory process is by direct extension along the fascial planes. Occasionally the development of subperitoneal abscess of hypogastric, iliac, inguinal, lumbar, or kidney regions is dependent upon a lymphatic extension. Morrissey reported 2 cases of perirenal abscess in which the infecting agent was carried by the lymphatics; one was secondary to trauma of the posterior urethra and was complicated by an early superior pelvirectal abscess; the other was secondary to a punch operation on the vesical neck. In rare instances, a lymph gland drawing a par-

ticular infected area may become the seat of a localized abscess which may spread to the adjacent subperitoneal tissues as occurred in a case of an iliac abscess following abscess of the prostate, which was reported by Bazy in 1893.

The possibility of extension of an infection along the length of an organ traversing the infected area, particularly the vas deferens and the ureter, must be borne in mind. In such cases, the infection may extend by way of the lymphatics accompanying such a hollow organ, or through the loose cellular tissues surrounding it, or through the lumen of the tubular structure. In this respect it is interesting to note the Herman's case of perirenal abscess occurring one week after insertion of an indwelling catheter for benign hypertrophy of the prostate where the infection was apparently due to a peri-ureteral extension of the pus from below upward and not by way of the lymphatics.

PREVENTION AND TREATMENT OF POSTOPERATIVE INFECTIONS

Fully cognizant of the serious and often grave consequences of postoperative infections, the surgeon is forewarned to guard against their appearance and to institute immediate and energetic treatment to eradicate them when such unpleasant complications arise. Fortunately, the occurrence of local and distant suppurations following suprapubic operations is rare. However, despite the careful preoperative preparation of the patient and the refinement and perfection of operative technique in recent years, we venture to say that postoperative infections are relatively more common than a survey of the literature would indicate.

Many operative precautions have been suggested by different surgeons with the thought in mind that the prevention of local complications is necessary to insure a speedy recovery and a perfect end-result. In a well planned and executed suprapubic cystotomy and prostatectomy, the following steps are of great importance: good exposure of the bladder; proper incision of the bladder; careful closure of the suprapubic wound with adequate drainage.

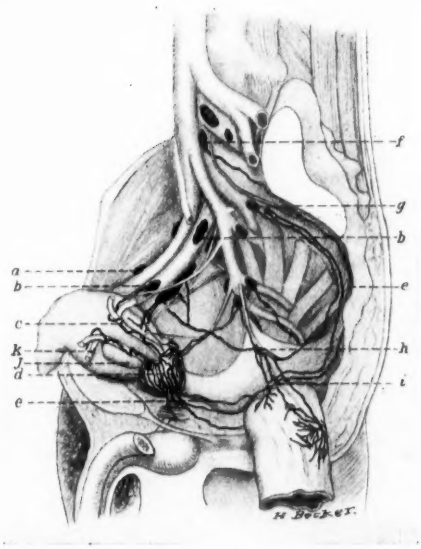

Fig. 8. Lymphatics of the prostate, seminal vesicles, and vas deferens (after Cuneo and Marcille). *a*, *b*, External iliac glands; *c*, efferent trunk from prostate to external iliac glands; *d*, retroprostatic glandular nodules; *e*, efferent trunk from prostate to gland of promontory; *f*, gland of the promontory; *g*, laterosacral gland; *h*, middle hæmorrhoidal gland; *i*, middle hæmorrhoidal trunk; *j*, seminal vesicles; and *k*, ureter.

Exposure of the bladder. One of the most important factors in eliminating postoperative infections is a careful and neat exposure of the bladder. Great care should be exercised in stripping the peritoneum off the bladder, as frequently the dissection is carried too far laterally and caudally, creating a retropubic dead space and exposing the neck of the bladder to unnecessary trauma. The superior border of the pubic bone should serve as the landmark for the lower limit of the exposure of the bladder in a suprapubic cystotomy or prostatectomy.

To prevent subperitoneal and prevesical space infections, Neff, as well as other surgeons, performs a preliminary operative procedure such as suturing the bladder to the skin or to the under surface of the rectus sheath and waiting 4 or 5 days until adhesions have closed off the prevesical space before opening the bladder. These same precautions

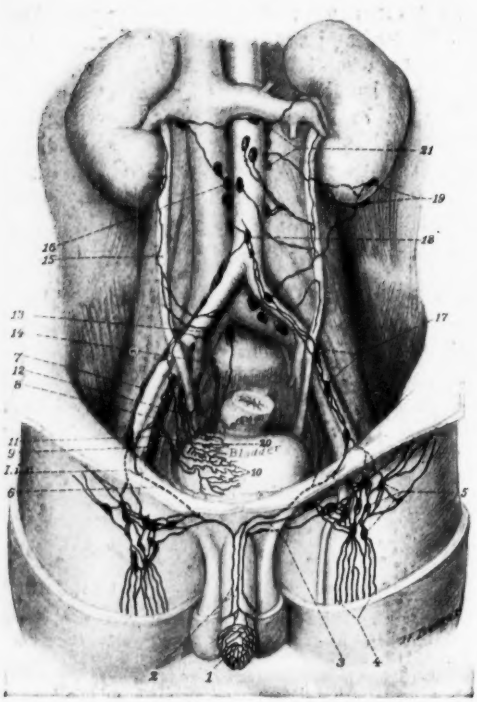

Fig. 9. Lymphatics of glands, penis, posterior wall of the bladder, ureter and renal capsule. *1*, Lymphatic vessels of glans and penis; *2*, lymphatic vessels of dorsum of penis and collecting trunks for lymphatic of glans; *3*, collecting trunk for lymphatics of penis to the inguinal lymph glands; *4*, lymphatics of thigh; *5*, inguinal lymph glands; *6*, collecting trunk from lymphatics of penis to external chain of iliac lymph glands; *7*, external chain of iliac glands; *8*, middle chain of iliac glands; *9*, internal chain of iliac glands; *10*, lymphatics of posterior wall of bladder; *11*, collecting trunks for lymphatics of bladder to iliac lymph glands; *12*, hypogastric glands with efferent lymphatics from bladder; *13*, gland of the promontory; *14*, lateral sacral glands with efferent lymphatic from seminal vesicles; *15*, ureter with lymphatics of the middle third; *16*, pre-aortic lymph glands; *17*, iliac lymph glands; *18*, lumbar lymph glands; *19*, lymphatics of renal capsule; *20*, interrupting nodules (*Shaltdreusen*); *21*, juxta-aortic glands; *I. i. r.*, internal inguinal ring.

may be carried out equally well at the time of the major operation before the bladder is opened.

Incision. The type of bladder incision used is often the determining factor in the speed of convalescence and the functional end result. In a simple cystotomy, the incision should not be carried too far down toward the neck of the bladder. The incision should be large enough to permit the introduction of the suprapubic tube and as a rule should not exceed 3 centimeters. In a suprapubic prostatectomy, the incision is of greater length in order to facilitate the removal of the prostatic growth. The incision may be enlarged in the direction of the fundus of the bladder or in a transverse direction. Some surgeons make their skin and bladder incisions entirely in a transverse direction depending upon retraction of the incision for adequate exposure. The transverse incision is particularly applicable to the open method of suprapubic prostatectomy.

It is imperative to safeguard against a sudden flooding of the operative area at the time of opening the bladder by carefully packing off the prevesical space or by introducing a cannula with or without a suction apparatus attached before incising the bladder. The bladder may be distended with air or washed out with sterile water prior to operating, to minimize the sudden outflow of pathogenic organisms. The value of preoperative drainage of the bladder through an urethral catheter in reducing bladder infection is, of course, obvious.

Closure. The important feature of the closure of the abdominal wound is adequate drainage of the space of Retzius by a wick or gauze drain placed at the lower end of the incision. A moderately loose closure of the wound insures better drainage. The suprapubic tube should be brought out in the upper part of the bladder and abdominal incisions to prevent the seeping of infected urine into the lower angle of the incision. Experience has shown that the placing of the suprapubic tube at the upper end of the bladder incision incurs little danger of infection of the peritoneum in this region. In old infected prostatic cases, it may be necessary to drain the prostatic bed perineally.

Treatment. Despite these operative precautions there may occasionally develop signs of infection in the various areas about the bladder and prostate due to the fact that surgical drainage in these cases is in an uphill manner and hence inadequate. One should not delay treatment until the classical signs

of suppuration are manifested but should institute immediate measures at the earliest evidence of infection, such as an unexplained persistent rise in temperature or pain on pressure in the region of the abdominal wound. It is folly to await the development of a suppurative process behind the pubic bone in the face of such symptoms and one should immediately institute drainage of the prevesical space. Often opening widely the lower angle of the abdominal incision with frequent lavage and irrigation supplemented by thorough drainage will clear up these impending infections. Occasionally, however, one must resort to perineal drainage of the prevesical space. The essential factor of such dependent drainage is the accurate placing of a drain which passes in front of the bladder behind the pubic bone to reach the inner side of one of the inferior rami of the pubic bone. This procedure is a relatively simple one and has been advocated by Legueu. He makes a small incision of 5 to 6 centimeters on the inner aspect of one of the inferior rami of the pubis and proceeds with his dissection into the ischiorectal space. A finger is then inserted in this space in an upward direction to reach the tip of a curved sound or a long Kelley clamp, which is introduced beforehand behind the pubic bone and pushed down the prevesical space into the perineum to the internal side of the inferior ramus of the pubis. When the end of the sound or clamp is palpated a small incision is made over its end and the instrument brought out through the perineal opening, and a drain is grasped or attached and brought back to the retropubic region. In this procedure one must avoid injury to the inferior rami and to the corpus cavernosus. When the infection is confined to the prevesical space unilateral perineal drainage will suffice, but when the infiltration has spread around the base of the bladder a similar drainage on the other side of the perineum should be made in order to drain properly the lateral and posterior surfaces of the bladder. When the infection has spread beyond the confines of the prevesical space down the inguinal canal or passes out of the obturator foramen to the deep parts

Fig. 10. Roentgenogram showing periosteitis and osteitis of the pubic bone following suprapubic prostatectomy.

of the inner thigh, it is necessary to supplement this subpubic perineal drainage with appropriate incisions and counter incisions at the most prominent points of localized suppurations.

The foregoing treatment of prevesical and retropubic infections is particularly efficient in cases following suprapubic cystotomy. However, after a suprapubic prostatectomy one must consider the prostatic bed as an additional source of infection. When the surgeon is reasonably assured that the prostatic bed is serving as the focus for the septic process, perineal drainage should be performed, the typical perineal approach to the prostate as described by Young being used. The fascial spaces about the prostate and bladder should be explored digitally and the capsule of the prostate incised. One or more drains should be passed through this opening in the prostatic capsule into the bladder to provide adequate dependent drainage of the bladder and prostatic enucleation cavity. It is advisable to drain the posterior periprostatic space by placing drains up to the posterior aspect of the prostatic capsule.

In the cases of slowly developing infections which occur in the late stages of convalescence, one must be prepared to combat a prevesical or perivesical cellulitis or a diffuse

pelvic suppuration which may extend by way of the lymphatics to the inguinal, iliac, lumbar, and thigh regions. These conditions are often fatal and require radical intervention to prevent the development of a septicæmia. The primary focus of infection must be attacked before one can hope to relieve the secondary suppurations developing in sites remote from the bladder or prostatic regions as these latter places mark the point of exit for infections. Consequently one should reopen and thoroughly explore the prevesical space and search for a hidden retropubic infection following suprapubic cystotomy. A perineal retropubic drainage should be performed in the manner aforementioned to establish dependent drainage of the areas about the prostate and bladder. If these complications occur following a suprapubic prostatectomy, perineal drainage of the prostatic bed should be supplemented. The secondary suppurations at distant sites should be incised and drained according to their degree and rapidity of formation.

For cases of osteitis of the pubic bone with infiltration of the muscles attached to the pubis giving rise to arthritic symptoms, we have obtained good results with quartz light therapy, diathermy, and massage used in conjunction with good drainage and curettement of the operative area.

CONCLUSIONS

1. A knowledge of the anatomical relations of the posterior urethra, prostate, and bladder, and their fascial coverings, is essential to a complete understanding of the infectious processes after suprapubic operations.

2. The postoperative infections about the prostate and bladder are the result of inflammatory processes propagated by direct extension and by the lymphatics. The blood stream is rarely the pathway of infection.

3. Infection of the prevesical space is the most frequent complication of suprapubic cystotomy and in most instances is due to a flooding of the operative field with septic urine introduced either at the time of operation or during convalescence.

4. Osteitis or periosteitis of the pubic bone is a distinct clinical entity and may develop after any suprapubic bladder operation.

5. Immediate treatment should be instituted at the earliest signs of impending infection.

6. When the infection has spread beyond the confines of this space to the region about the neck of the bladder, the subpubic perineal approach as advocated by Legueu provides adequate dependent drainage of the prevesical and perivesical region.

7. The proper treatment of local or distant suppurations following suprapubic prostatectomy requires early recognition of the fact that the prostatic bed is usually the source of such infection and demands immediate drainage of this area.

8. The perineal approach offers the best surgical drainage of suppurations about the prostatic bed.

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TEMPORARY DIVERSION OF THE URINE BY PYELOSTOMY IN REPAIR OF THE URETER[1]

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THE end-results of attempted repair of ureters injured during the course of gynecological or other pelvic operations have generally been disappointing. It is almost an axiom, at least to French and German urologists, that once the ureter has been severed the kidney is for all practical purposes an irreparable loss. Even if the absence of a severe infection obviates immediate nephrectomy, total functional loss is eventually to be expected due to degeneration of renal tissue as a consequence of the disturbance of urinary excretion.

The danger of infection may be appreciated when one considers the unavoidably septic operative field usually encountered in such pelvic conditions as salpingitis, carcinoma of the cervix, and so on. Injuries to the ureters are seldom reported and the time elapsing before the appearance of recognizable postoperative infection may vary from a few days to several weeks, especially in the presence of a ureterovaginal fistula. The seriousness of this latter complication in a patient already weakened from an extensive and difficult operation may be considerable. Weibel, for instance, reports 66 cases of ureterovaginal fistulæ following operative injuries among which were 8 nephrectomies for pyonephrosis and 8 deaths. Pasteau reports one such case as having been saved by secondary nephrectomy. Marion reports that in 3 patients within 2 to 8 weeks after ureterovesical implantation, there were 3 deaths due to pyonephrosis. Deniker and Le Gac report nephrectomy revealing a cystic and infected kidney 2 months after ureteral repair. Finally, Delbet cites a case in which extraordinary difficulties were encountered during the course of a secondary nephrectomy, the kidney being involved in such extensive perinephritis that the inferior vena cava was unwittingly ligated and cut.

In the absence of any infection, renal degeneration nevertheless inevitably supervenes upon ureteral obstruction. According to Hinman, the mechanism of this degeneration depends upon a preliminary ureteral dilatation followed by a subsequent atrophy of the renal parenchyma. Progressive changes in two such stages are seen in the cases reported by Ash in one of which the patient never having suffered any difficulty had been considered cured until a cystoscopic examination revealed the absence of ureteral peristalsis and complete obstruction to the ureteral catheter on the side operated upon.

Stenosis of the ureter may develop very slowly. In the case reported by Chaton, the ureter remained patent and the kidney showed normal function for almost a year before the ureter became obstructed. Dujarier reports a case in which 5 years after operation the affected kidney showed 50 per cent normal renal activity but in which within another 5 years the ureter had become completely obstructed.

When degeneration takes place, in spite of the patency of the ureter, the etiological solution of the problem becomes very difficult. In the case reported by Lenormant the ureter could be catheterized but the kidney excretion was found to be only one-third normal. In general, however, renal atrophy is a slow development. Marion reports a case in which the ureter remained patent for 19 years, the kidney meanwhile gradually having lost all functional value and showing upon removal complete hydronephrotic degeneration and even the presence of a small and unsuspected carcinoma. Similarly a kidney examined by Descomps 27 years after a reparative operation was found entirely cystic. Later we shall discuss certain theories in regard to these cases of slow degeneration.

It is clear that one must be extremely conservative in appraising the results of ureteral repair. An attempt at such repair can be deemed successful only when catheterization is possible and kidney function normal on the

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Fig. 1. Longitudinal section of repaired ureter showing perfect healing of mucous and muscular layers on the left, and prevention of such healing on the right due to eversion and interposition of mucosa caused by incorrectly placed suture. ×25.

side operated upon. Observations over long periods and including these indispensable tests are few because patients not actually suffering hesitate to return to the surgeon for only routine cystoscopy and ureteral catheterization.

In brief, in accordance with the view that loss of kidney function inevitably follows attempted repair of the ureter, most surgeons consider anastomosis of the severed ureter inadvisable, believing that the kidney should be removed.

Marion and Legueu even go so far as to state that suture of the ureter is not only useless but distinctly dangerous in view of the high percentage of infectious complications, ultimate destruction of renal function being inevitable at best. The basis of such an assumption, however, is questionable, for after all we know very little concerning the real cause of secondary renal degeneration and a hasty, routine nephrectomy is in itself not without danger.

In considering the dangers of nephrectomy, it need hardly be mentioned that the primary danger is in the removal of a kidney in cases in which the actual functional condition of the remaining kidney is not known and especially in cases in which there is reason to believe it impaired. Injury to the ureter in a gynecological operation occurs only in difficult cases, as in dealing with tumors of the broad ligament where there is more or less alteration in the normal anatomical relationships. The ureter in such cases may cross the tumor and be surrounded by dilated veins from which it is quite indistinguishable (Gosset). Similar difficulty may be encountered in an old adherent salpingitis in which separation of the tube necessitates a procedure called "American" in France and which, according to Lenormant and Leibovici, is most dangerous for the ureter. The operative treatment of carcinoma of the cervix is not without danger especially when extensive infiltration forces the surgeon literally to dissect the ureter from the parametrium. Moreover, in each of these cases the ureter may be so displaced and compressed that renal function is seriously interfered with.

On the other hand, certain carefully examined cases followed over a long period have been reported in which the renal function has shown little if any impairment. Classic examples of such comparatively successful attempts at ureteral repair are those of Reed, Delbet, Brizacki, Friedrick, Bourniot, and more recently those of Rochet, Lenormant and Leibovici, and Chifeliau. Chifeliau's case is particularly instructive for when the patient was examined 19 years after ureteral repair both ureters were found patent and kidney function tests showed insignificant difference between the two sides. Similarly both kidneys in a patient operated upon by Petit were found after 18 months to be identical in functional value. With evidence such as the foregoing there seems to be little basis for rejecting repair of the ureter as a procedure which may afford a long period of good functional activity if not an actual recovery.

The disturbance in urinary excretion following ureteral injury presents a problem to be solved on either a physical or a physiological basis. Dilatation and renal degeneration as a consequence of ureteral stenosis would seem to involve a physical factor, while paralysis of the smooth muscle of the ureter might appear purely physiological. Marion considers the paralysis to be due to section of the muscle fibers and interruption of their con-

tinuity by scar tissue. In the severed ureter both ends may be observed to contract more or less feebly even when completely isolated. In the repaired ureter, however, peristaltic waves do not pass through the scar at the line of anastomosis.

On a physiological basis the inertia of the ureter and the renal atrophy in spite of a patent ureter may easily be explained; urine being excreted only when pressure within the kidney pelvis exceeds that within the bladder, all the work of excretion is thrown back on the kidney thereby profoundly disturbing its secretory mechanism. In such event repair of the ureter would be useless since it has presumably proved fatal to the physiological mechanism of both excretion and secretion. In the present investigation, however, careful consideration of these very points of pathological physiology has led to quite an opposite conclusion, namely, that stenosis is the cause of ureteral inertia, the inertia being an immediate consequence of the dilatation following the repair. Stenosis, therefore, must be prevented, and the difficulty encountered in its prevention is in direct proportion to our ignorance of its causes.

Analogy between the present problem and that concerned in traumatic rupture of the urethra comes naturally to the mind, for whenever one or other of the urinary ducts is severely injured stenosis is the usual sequel. With few exceptions, until the urine was diverted by cystotomy, the results of urethral repair were deplorable. Stenosis accompanied by general dilatation of the upper urinary tract occurred and was followed by renal insufficiency, infection, and finally by death. After Rochet, Marion, and Heitz-Boyer had demonstrated the advisability of systematic diversion of the urine by preliminary cystotomy, the results of urethral repair uniformly improved leading one to conclude that the passage of urine over the suture line must be prevented during the period of cicatrization.

Diversion of the urine from the urethra by cystotomy is comparatively easy; an analogous diversion from the ureter is quite another problem. Hinman attempted ureteral diversion by simple nephrostomy in a case of chronic cystitis but although the kidney was kept open for 3 months and a small quantity of urine flowed outside there was no improvement of the bladder disturbance until permanent ureterostomy was performed. Similarly pyelostomy, even with the maintenance of a tube in the kidney pelvis, has proved inadequate for complete drainage. The operative opening has a strong tendency to spontaneous closure as have all such fistulæ connecting with an open tract, a tendency well recognized in surgery and seen for example in the spontaneous closure of such fistulous tracts as gastro-enterostomy in the absence of pyloric obstruction, of the common duct after biliary drainage, of intestinal fistulæ following the relief of obstruction, and of a pyelostomy after removal of a calculus. Moreover, one may make use of these same examples in arriving at the opposite generalization that a fistula will stay open as long as the normal excretory passage is obstructed, a generalization which forms an important basis for the present experimental work: a bougie of sufficient caliber to block the ureter having been introduced distally through the opening of a pyelostomy, the urine may readily be diverted through a catheter in the renal pelvis introduced through the same opening and the fistula will show no tendency to close as long as the normal course of the urine is obstructed but will close at once upon removal of the bougie from the ureter.

THE EXPERIMENT

The present experimental research has been carried on in general from two aspects: first, consideration of the surgical value of temporary urinary diversion; and second, consideration of the physiology of the repaired ureter. Before discussion of the conclusions drawn from the experimental data obtained the actual operative technique of the various essential procedures will be described.

OPERATIVE TECHNIQUE

Pyelostomy. The kidney having been exposed by lumbar incision the renal pelvis is opened and a No. 8 to No. 12 bougie, according to the size of the experimental animal, is introduced downward into the ureter. The bougie is held in place by a transfixing suture

with avoidance of unnecessary trauma to the ureter, and a small catheter is inserted just within the kidney pelvis. In the closure of the wound it is essential in the dog that along the posterior side of the kidney be placed a strip of gauze which before its removal in about 5 days markedly favors the formation of adhesions between the kidney and the posterior abdominal wall and thus largely removes the danger of peritonitis. In the closed operative wound one sees the bougie at the upper angle and the catheter and gauze strip at the lower angle. The bougie and catheter must be cut so as to project about half an inch outside the incision in order to allow for displacement of the kidney when the animal is up and to prevent the animal from tearing out the tubes.

Repair of the ureter. In the present experimental work end-to-end anastomosis of the ureter was employed. This type of repair seems more suitable in clinical surgery than anastomosis by invagination or by laterotermination implantation even though good results by these latter methods have been found by Bloodgood in experimental surgery. The mere method of anastomosis, however, is not the solution of the problem of ureteral repair, for were it so the problem would long since have been solved judging from the many ingenious methods which have been published (Bier, Young). The author believes that the solution lies in diversion of the urine, and consequently the simplest and most rapid technique of repair, namely, end-to-end anastomosis must be employed.

Following lateral laparotomy the ureter is mobilized and carefully sectioned after being isolated on a Kelly clamp. The ureteral vessels which are preserved prevent excessive spreading of the severed ends. Four fine black silk sutures are passed inward through the lower end and outward through corresponding quadrants in the upper end. By this procedure sutures in each quadrant evert the mucosa and have their knots outside of the ureter. The necessary ectropion of the mucous membrane caused by this technique presents difficulties which, however, are not insurmountable. The photomicrograph (Fig. 1) shows a striking illustration of this difficulty. On the left side the sutures have been correctly placed, close to the ends of the ureter. There is no ectropion and one sees how much more readily muscular repair takes place where there is no interposed fibrous tissue or mucosa than where re-establishment of muscle fiber continuity is prevented by such everted layers. On the right side, the first suture to be placed had broken while being tied. A second suture placed with greater difficulty included too much of the tip of the ureter and caused eversion of the mucosa in the form of a true mucous channel making cicatrization impossible. Since mucosa was approximated to mucosa a partial fistula with inflammatory reaction ensued and epithelium proliferated outside of the lumen along the adventitia of the ureter. With an everting suture it is difficult to avoid ectropion, and an inverting suture which would at once constrict the lumen of the ureter could not possibly be employed. However, were the mucosa of each ureteral extremity destroyed by careful use of the thermocautery to just the extent to be included in the suture, anastomosis would unite muscle layer to muscle layer and bring together the edges of normal mucous membrane. Such procedure would favor quick repair and even were there a break in the continuity of the mucosa it would be regenerated completely within 5 days as reported by Kramer. This was also observed in this series.

RESULTS

The preliminary procedure of pyelostomy with temporary obstruction of the ureter was performed on 12 dogs. In the first series, animals 5 to 10, postoperative peritonitis was fatal in each case. In the second series, animals 4 and 11 to 16, a gauze strip was used as described above with one operative death, dog 16. Dog 4 died after 31 days from a retroperitoneal infection. Dog 15 died on the fifty-fourth day. The cause of death was not determined.

In each case the fistula functioned perfectly for 4 or 5 days, a period varying with the amount of activity of the animal and with the degree of the unpreventable infection at the site of operation. The presence of the catheter

in the renal pelvis was found non-essential and was not used in the last three animals, the fistulæ functioning perfectly as long as the bougie was not displaced. Within 24 hours after the bougie was withdrawn, however, not a drop of urine appeared at the opening. Eight to 15 days were usually necessary before complete healing of the wound, again the result depending on the degree of infection. Infection is, of course, a great hindrance to good experimental results and incisions which have been drained seem always to become infected under experimental conditions. The dog, moreover, is not the most favorable subject for the study of ureteral repair, for in the absence of infection the results are always good, as shown by the work of Bloodgood, Alskne, Gouverneur, and Kramer.

Although the results of the foregoing procedure show that temporary pyelostomy will remain open as long as an artificial obstruction is in place and that it will close spontaneously upon withdrawal of the obstruction, there is no warrant for any far reaching deductions concerning the usefulness of the procedure in repair of the ureter since the experimental conditions encountered were so unfavorable.

In order to follow the processes of ureteral repair, a certain number of animals were sacrificed at regular intervals after anastomosis. With a wide opening of the abdomen it could easily be seen that contractions of the ureter were present and could be stimulated by pinching. Under ether anæsthesia, kymograph records of ureteral contractions were made by means of a technique modified from that of Penfield. Four superficial sutures were passed through the ureteral wall at exactly measured intervals and each suture was fastened to a recording lever. The tracings, however, simply confirmed what could already be seen. Normal contraction of the ureter extending from the kidney pelvis to the bladder could be observed regularly every 20 to 25 seconds.

In the severed ureter, peristaltic contraction was not impaired at the moment of operation, the intermittent wave of contraction being sufficiently vigorous to push a probe out of the lumen of the upper portion of the ureter. After 24 hours, however, the entire upper end of the ureter was found to be absolutely inert, excitation awakening no contraction in this portion although a slight response could be evoked in the lower portion. On the fourth day, as seen in animal 20, slight peristalsis could be observed, the waves of which seemed to fade out before the line of suture was reached. On the eighth day, in animal 19, the central end was found inert but the peripheral end showed contraction upon suitable stimulation. Until the eighth day the mere section of the ureter brought about this result: paralysis of the central portion while peristalsis in the peripheral portion remained intact.

Further study of the end-results shows that after the seventh week the ureter regains its motility in degree depending upon the condition of the anastomosis. Where stenosis of this junction occurred, as in animal 14 on the fifty-seventh day, the upper end was found dilated and apparently inert. There was not complete paralysis, however, since feeble contractions could be seen passing over the suture line. The contractions were more frequent than in the normal ureter but for two or three contractions in the upper portion there was only one contraction in the lower end. The physiological union between the two extremities appeared to be absolutely interrupted by the cicatrix, an observation previously reported by Alskne. The central dilatation following ureteral stenosis would thus appear to be not so much a matter of paralysis as of atony by distention.

On the other hand, animal 15, sacrificed on the fifty-fourth day, presented an apparently normal ureter in which frequent and vigorous peristaltic waves were clearly observed to pass from end to end across the line of suture. Similarly, the ureter in animal 13, sacrificed on the sixtieth day, showed perfect motility, spontaneous as well as provoked, with contraction waves passing from one end to the other. Again, in animal 2, in which section was made so close to the bladder that it was impossible to see the contraction of the lower end, upon sacrifice after 102 days the upper portion of the ureter was found not to be dilated but to have a perfectly strong and regular motor activity.

From the foregoing observations it seems certain that ureteral paralysis following sec-

tion affects only the central end. This paralysis disappears and motility returns after the first week if there has been no development of stenosis at the line of suture. Ureteral paralysis of itself has no effect on the kidney. The cause of the renal damage is in the secondary dilatation following stricture of the ureter and leading to an atony by distention. Furthermore, although one would hesitate to draw any definite conclusion concerning the influence of pyelostomy on ureteral repair, attention must be called to the fact that animals 13 and 15, in which after about 8 weeks practically normal ureters were found, had each undergone temporary pyelostomy.

The present investigation has shown that ureteral section does not necessitate nephrectomy as formerly claimed and that the development of stenosis is the most serious complication encountered in the repair of such injury. It would seem, therefore, that the avoidance of stenosis of the ureter should be a primary consideration and that diversion of the urine by pyelostomy and temporary obstruction is the operative procedure of choice in all attempts at repair of the ureter.

Nephrectomy is indicated without question, however, in cases in which the repair of ureteral injury will certainly be followed by infection. Pyonephrosis is especially dangerous early in the postoperative course. Hinman in this connection has shown both experimentally and clinically that renal atrophy is always preceded by distention, and cites among 17 cases of ureteral ligation followed by late nephrectomy 14 cases of hydronephrosis. In addition, in 64 cases found in the literature only 20 failed to show pain or a mass on the affected side. With such evidence it is not difficult to understand the increased spread of infection as atrophy develops.

Nephrectomy must not be done, however, unless the remaining kidney is found functionally competent to meet the added burden imposed upon it. If the condition of the remaining kidney is not known, pyelostomy with ureteral obstruction is to be done. This procedure, without any tentative repair or even ligation of the ureter, the dangers of which have been shown, prevents the flow of urine over the injured area and secures urinary elimination while allowing the patient to recover sufficiently to undergo cystoscopy and ureteral catheterization. Should the opposite kidney be found sufficiently normal at this deferred examination, nephrectomy is performed to free the patient of her fistula. Should the opposite kidney be judged incapable of carrying on renal function alone permanent ureterostomy should be performed, the severed ureter being brought directly to the skin, since pyelostomy is only a temporary procedure.

The question of the advisability of colic implantation as treatment of surgical section of the ureter is an unsettled one. In France such treatment has not found favor, but since the procedure of Coffey can conveniently be employed the danger of an ascending infection seems negligible. An interesting modification of this operation has been proposed by Mayo who has reported numerous cases dealing exclusively with the treatment of vesical exstrophy. It is evident, however, that the injuries left in the pelvis by a difficult hysterectomy would cause most surgeons to hesitate in opening the intestinal tract.

The procedure here presented is simple, rapid, and requires no special instrumentation. While the ureter is being sutured and the abdominal wall closed, a series of bougies of appropriate sizes, No. 12 and up, usually, can be sterilized and pyelostomy immediately performed with little added shock to the patient. In place of a long and difficult procedure, one has here a new and important operation of emergency.

The use of an indwelling ureteral sound through pyelostomy has been reported by McArthur in a case in which the ureter had suffered extensive traumatic loss of substance, the procedure being inspired by an analogous method of treating loss of substance of the common duct after operative injuries. Kramer in his recent experimental studies asserts that the obstruction of the ureter in such cases of urinary diversion is always the most important factor, for while drainage might appear dependent on a catheter in the renal pelvis, it is actually due to the fact that the ureter is obstructed by a solid bougie.

CONCLUSION

The usual procedures of repairing a severed ureter generally lead to a more or less rapid degeneration of the kidney. As immediate nephrectomy cannot always be performed, there is need for a new operative technique. The essential part of such technique is the diversion of the urine during the period of ureteral repair, a period experimentally necessitating about 5 days. Urinary diversion is obtained by pyelostomy together with obstruction of the ureter by a bougie. As long as the bougie is in place there is continuous drainage. As soon as the bougie is withdrawn the urine takes its normal course and the fistula closes spontaneously.

The ureter should be repaired by end-to-end anastomosis with four everting sutures after removal of redundant mucous membrane along the ends to be brought together. The removal of mucosa obviates its eversion which would otherwise prevent primary healing.

Diversion of the urine permits cicatrization of the severed ureter without the development of stenosis just as cystostomy checks the formation of traumatic stricture of the urethra. By preventing ureteral stenosis this procedure removes the cause of dilatation, atony, and finally complete renal atrophy.

It is to be hoped that this method, experimentally suggestive of great possibilities, will be given the trial it deserves and its value confirmed by distinctly clinical data.

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THE DEMONSTRATION OF A TRUE INTERNAL INGUINAL SPHINCTER AND ITS ETIOLOGIC RÔLE IN HERNIA

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IT is our purpose, in this preliminary article, to advance an original conception of the etiology of inguinal hernia and to substantiate that conception, in so far as possible, and throughout, to indicate its applicability in the treatment and cure of the comparatively common affection under discussion.

At the present time, the theories advanced in explanation of the etiology of inguinal hernia are many and demonstrate by their mere multiplicity the fact that the subject is far from settled. Thus, inguinal hernia has been attributed to such various conditions as constitutional diathesis, lengthened mesentery, increased intra-abdominal pressure, and, especially lately, the presence of a congenitally preformed inguinal sac. That all of these factors, in selected instances, have a direct etiological relationship to inguinal hernia can not be doubted. However, it has long been our contention that the most important factor in the etiology of inguinal hernia is an insufficiency of sphincteric action on the part of the muscular ring at the internal opening of the inguinal canal, and that the factors mentioned above are only secondarily concerned in the final production of the peritoneal and visceral extrusion.

In outline, our thesis may be stated as follows:

Surrounding the spermatic cord at the internal abdominal ring is a muscular structure for which the name "inguinal sphincter" is entirely justified. The sphincter is voluntary in character and, indeed, possesses a distinct motor supply. Functionally, it protects the internal ring, first, by a normal state of tonus, and, second, by voluntary contraction whenever the intra-abdominal tension is increased through abdominal muscular strain. When, however, the sphincter becomes, for any reason, relaxed or atrophic, the internal opening of the inguinal canal is left sufficiently patent to accommodate an entering wedge of peritoneum, extruded by the variations in intra-abdominal pressure. Sphincteric relaxation may be produced in a variety of ways, as, for instance:

1. Prolonged, exhaustive abdominal strain such as may be produced by a constant, tiring cough, hard labor in a stooping position, abdominal tumors, etc.

2. A sudden, severe increase in intra-abdominal tension, which may either overcome the sphincter, or, literally, catch it off its guard.

3. Atrophy of the sphincter, induced by section of its motor nerve supply, such as may occur in the course of certain laparotomy incisions, notably the Davis and McBurney.

In any case, the entering wedge of peritoneum by dilating and inducing paresis of the inguinal sphincter, initiates a vicious circle which greatly favors the final production of the hernia.

The proof of this thesis is evidently difficult, in that most hernias are seen at so late a stage that all original sphincteric activity has been obliterated and may not be evident to the examiner or operator. Such evidence as is available, therefore, will lie along anatomical, empirical, and experimental lines and may be briefly anticipated as follows:

A. *Anatomical proof.* Under this head, the anatomy of inguinal hernia will be considered, and the actual existence of a muscular sphincter at the internal inguinal os, demonstrated. Further, it will be shown that hernia is physically impossible as long as the normal tone of this sphincter is maintained.

B. *Empirical proof.* In this section, it will be shown that the various secondary factors of heredity and constitutional diathesis can be scientifically correlated with our present conception, and that the older theory of congenital sacculary patency presents defects which render it untenable as a satisfactory explanation of the etiology of inguinal hernia.

C. *Experimental proof.* This, to substantiate our premise, would naturally be directed along the following lines of investigation:

1. To demonstrate the presence of an internal inguinal sphincter in such laboratory animals as are available.

2. To investigate the structure, function, and nerve supply of that sphincter.

3. To determine the effect of experimental paresis, such as may be induced by section of the motor nerve supply to the sphincter muscle.

Finally, to determine the applicability of all our findings to the treatment and operative cure of inguinal hernia.

The evidence obtained by the lines of investigation outlined above will be presented and elaborated in the following sections.

ANATOMICAL PROOF

The existence of a distinct sphincteric muscular ring at the internal opening of the inguinal canal, seems, heretofore, to have been nowhere recorded in the literature. Several observers, however, have recognized the "sphincter-like" or "shutter-like" action of the muscles of this region. Thus, Hammond (13), in describing the internal ring, writes as follows:

> Immediately above and in front, lie the curved muscular fibres of the internal oblique and transversalis, which, in contracting, become opposed to Poupart's ligament and act as a sphincter to close the internal ring, compression of the spermatic vessels being prevented by the downward convexity of Poupart's ligament.

Darling (14) also described the superior portion of the sphincter as follows:

> In cases of deficiency of the conjoined tendon, the "inguinal sphincter" must be defective in action, because the movable lower border of the transversalis cannot be approximated to the inguinal ligament.

Again, Cawell (3) described a vascular ring surrounding the internal opening of the canal and remarked upon the similarity of its architecture to that of vessels ordinarily supplying sphincteric musculature.

As to why these observers stopped with only a partial description of an easily demonstrable structure, no explanation is forthcoming. In our series of dissections, and in the experimental work to be described later, not only was a "sphincter-like" action of the muscles demonstrable, but the actual existence of a well developed muscular sphincter at the internal ring was proved. The structure may easily be demonstrated by the following dissection.

Expose the external ring by a 10 centimeter oblique incision through the skin and superficial fascia, in the direction of the lower pillar. Expose the cord and internal ring by reflecting the external oblique aponeurosis downward from an incision 4 centimeters above, and parallel to, Poupart's ligament. By appropriate dissection, it may now be demonstrated that the so-called "arching fibers" at the attachment of the conjoined tendon around the ring, not only arch over the cord, but actually course completely around it, interposing themselves, below, between the cord and the inguinal ligament. In this manner, the contained muscular fibers form a complete and grossly definable sphincter for the canal at its abdominal opening. It is our contention that this sphincter is demonstrable in all normally developed individuals and that relaxation of its fibers is the primary factor in the causation of the great majority of inguinal hernias.

EMPIRICAL CONSIDERATIONS

Under the heading "The Etiology of the Inguinal Hernia," most authors, after outlining the congenital sac theory, generally classify the currently accepted causes as either (1) predisposing or (2) exciting. We shall follow a similar plan but attempt to co-ordinate these factors with our newer conception of the basic etiology. The classification may be given as follows:

Predisposing causes. 1. The congenital sac. The current theory of the etiology of inguinal hernia is based upon this structure and postulates that a hernia is produced by the invagination of peritoneum and abdominal contents into a patent, subinvoluted processus vaginalis, e.g., that process of peritoneum which precedes the testicle in its descent into the scrotum. Of late, however, investigation has uncovered evidence which is directly at variance with this theory. To begin with, Macready (9) observes that:

> If an unclosed canal were universally attended with rupture the number of ruptures . . . would be very much greater than it is.

Murray (5) considers that if the theory had any bearing at all, its applicability would be limited to infants, in which the sac is characteristically long, narrow, and distinctly constricted at its proximal end. In children and adults, however, the same author invariably found that the sac did not resemble the congenital tunica vaginalus but was always of a clearly differentiable acquired form and as constantly associated with atrophy of the muscles surrounding its abdominal opening. The sac in these instances, moreover, closely resembled that of a postoperative ventral hernia, in that it was a simple conical process of peritoneum evaginated through a relaxed abdominal, muscular os.

The support lent our theory by these findings is evidence, since the etiological relationship of the congenital sac to inguinal hernia, in adults at least, is thus proved to be the exception rather than the rule.

2. Heredity. According to Eccles (14), 25 per cent of all persons suffering from hernia give a definite history of familial predisposition. Andrews found a large number of hernias in individuals who showed other congenital malformations. Moorehead states that:

> The family history of hernia is often surprising, and points to some transmitted strain of muscular deficiency as typical as a facial feature or a birthmark.

—a deficiency, obviously, which would directly concern the inguinal sphincter. Morrison cites a case in point in which, out of an immediate family of 19 in three generations, 13 had inguinal hernia.

3. Nutrition. The importance of the maintenance of muscular tone is illustrated by the 20 per cent increase in the incidence of inguinal hernia during the world war starvation period in Germany (15). Were the occurrence of hernia to depend on the mere presence of a congenitally preformed inguinal sac, no explanation for this marked periodic increase would be forthcoming.

4. Age. The examination of a large number of cases tends to show that, after the first year, in which hernia is most frequent (13.3 per cent), the incidence of hernia is greatest during the years in which life is most active. The importance of the activity factor is illustrated by our own experience with hernia during the world war. Recruits, called from sedentary occupations to relatively strenuous military service, developed a high incidence of hernia during the early period of training. In commenting on this point, Watson (15) remarks:

> If the muscles (i.e.—the internal inguinal sphincters) could withstand the strenuous unaccustomed exercise for the first few weeks, the added resistance that comes from such training made the later appearance of hernia infrequent.

5. Occupation. Statistically, hernia is most frequent in patients continuously subjected to severe abdominal strain, especially in the stooping position. Thus, stokers, coal-heavers, plate-layers, gardeners, etc., seem to be peculiarly liable. It is difficult to see how this occupational incidence can be explained by "the increased frequency of the presence of congenital sacs." The fact, however, directly supports our theory. Stooping causes the inguinal sphincter to function at a distinct disadvantage,—while strain during this position causes a marked increase in intra-abdominal pressure. It is, therefore, quite conceivable that sudden and repeated strains, under these circumstances, will cause the extrusion of a gradually enlarging peritoneal cone, through the internal ring and into the inguinal canal. The process is then accelerated by the accompanying pressure paresis of the inguinal sphincter.

Of equal significance is the comparatively high incidence of double hernias in these instances (15).

6. Hernial diathesis. Eccles observed a peculiar "triple bulging" of the abdomen in subjects with a predisposition to inguinal hernia, in which the abdominal muscles, where not bound down by fascial attachments, formed three circumscribed ventral protruberances. A related type has been described as associated with prolapse of the mesentery, in which the upper part of the abdomen is flat, while the lower is lax and protuberant. According to our conception, however, both the bulging

and the hernial diathesis are adequately explained by the generalized weakness of the abdominal musculature and the consequent insufficiency of the internal inguinal sphincter.

7. Lipoma in the inguinal canal. This factor was given prominence by Speed, who in 154 hernia operations, found lipomata in 47.4 per cent. Another generally accepted cause of hernia is the presence of an undescended testicle in the inguinal canal. We believe, however, that both of these factors act through the constant dilatation and consequent weakening of the internal sphincter and thus indirectly produce the subsequent invitation to hernial protrusion.

8. Hernia following appendectomy wounds. This, according to Watson, is more common than is generally supposed being especially frequent following the McBurney incision. The explanation is again evident, since the muscle-splitting is directly in the course of the motor nerves to the muscles of the internal ring. Section of these nerves, with consequent degeneration of the sphincter, would, in our conception, adequately account for the undoubtedly high incidence of these hernias.

The exciting causes. Under this head, most authors list such "directly" productive causes as: pregnancy, parturition, chronic cough, ascites, abdominal tumors, tight-lacing, etc. It is evident that the common factor in all of them is a constantly high intra-abdominal pressure. We believe, however, that such causes can act only indirectly, either by causing sphincteric weakness, or by inducing hernial protrusions at such moments when the sphincter happens to relax. A comment in point is made by Murray, who observes,

> In a person with a perfectly formed abdominal wall, I believe it to be impossible for a hernia to occur.

It is evident, therefore, that clinical experience is in accord with our theory of the sphincter atonic causation of inguinal hernia, and, in fact, is explained most satisfactorily by such a conception.

EXPERIMENTAL PROOF

The above review of the literature gave the author ground for the belief that animal experimentation would, quite probably, throw further light on the subject. In this preliminary paper, the report of one such experiment will be submitted, with the full understanding that further laboratory and operative investigation is essential before final conclusions can be reached.

The method. A large dog was etherized, and its lower abdominal region, thighs, and genitals were shaved and prepared. Aseptic and antiseptic precautions were observed throughout the experiment.

On the right side, an incision through skin and fascia was made one inch above, and parallel to, the inguinal ligament. The internal ring was next exposed, in a manner similar to that employed in the human, by dividing and retracting the external oblique along the course of the spermatic cord. The inguinal sphincter in the dog operated on was found to be a well-defined, ring-shaped body of muscle fitting snugly around the cord where the latter dropped into the abdominal cavity through the origins of the internal oblique and transversalis muscles. The spermatic cord was then doubly ligated and cut about two inches from the abdominal ring, in order to obviate the action of the cremaster. The end of the proximal ligature was left long for use as a retractor.

Attention was now devoted to the inguinal sphincter. Minimal stimulation with the electrodes of an induction coil produced well-defined circular contractions of the cord. It was significant that the circular contractions involved the entire sphincter and were produced, in equal degree, indifferently as to which portion of the sphincteric ring was stimulated. The constriction of the cord was sufficient to diminish markedly the bleeding from a cut in the spermatic artery and firmly to fix a probe inserted through the sphincter alongside the vas. Significantly also, at no point of stimulation anywhere in the inguinal region could an only partial constriction of the sphincter be obtained, as had been described in the human, for the "sphincter-like" action of the superior arching fibers of the transversalis and internal oblique. As is true of sphincters in general, the internal ring either contracted *in toto* or not at all.

By careful dissection, the sphincter was removed, slipped over the cut end of the cord, and preserved in formalin for serial section. The muscles were then secured by buried catgut sutures, and the skin wound was approximated by silver wire.

On the left side, a different procedure was followed. It was our purpose here to isolate the nerve supply to the inguinal sphincter, determine its identity, and by neurosection, attempt to produce a definite atrophy of the sphincteric ring. Accordingly, a rather long (8 centimeters) oblique incision was made directly through skin, fascia, and external oblique, the former two structures retracted, and the latter widely separated by blunt dissection. The iliohypogastric and ilio-inguinal nerves were then isolated in the fascial plane between the external and internal oblique muscles, and the motor distribution of the branches of each determined by minimal stimulation with the electrodes of the induction coil. By this means, a small branch of the inguinal division of the ilio-inguinal, running inferiomedially to the region of the internal abdominal ring, was isolated. Stimulation of this branch invariably produced a circular constriction of the inguinal sphincter, as surely as had direct stimulation of that structure.

After proper identification, a small section was removed from the nerve and the wound closed in a manner similar to that employed on the opposite side. A sufficient time (8 days) was allowed to elapse for the degeneration of the sphincter, during which interval the dog was kept in as good condition as possible. At the expiration of this period, the left incision was reopened. The inguinal sphincter was then found to be relaxed to such an extent that the cord merely dropped into the abdomen through an opening 2.5 centimeters in diameter, whereas the surrounding muscles were uninvolved. The dilated left sphincter was then dissected out and also removed for serial section.

Results of the experiment. The reasons for, and the significance of, the various parts of the experiment have already been indicated in the description given above. Primarily, our investigation indicated that, in the dog at least, an inguinal sphincter, distinct in structure and nerve supply, existed. Further, the procedure showed that the sphincter acted as a physiological unit and functioned, when stimulated, to close the internal opening of the inguinal canal.

Careful study was subsequently made of serial sections obtained from the normal (right) inguinal sphincter. The microscope revealed the presence of skeletal muscle only, smooth muscle fibers being absent from all of the sections. Apparently, then, the inguinal sphincter resembles the outer sphincter of the anus in that both are entirely voluntary.

The serial sections obtained from the degenerated (left) inguinal sphincter were submitted to Dr. Davis, head of our pathology department. His diagnosis confirmed our conclusions, in that again smooth muscle was reported absent, whereas the skeletal muscle and nerve tissue present in the sections showed a type of degeneration typical of that following motor nerve rhexis.

CONCLUSIONS

The work already done, while not extensive, nevertheless indicates the importance of the following conclusions:

1. Clinically, the sphincter atonic theory of the causation of inguinal hernia satisfactorily explains the etiology of the greatest number of cases, irrespective of the presence of a congenital sac or such other minor factors.

2. Anatomically, the existence of the sphincter can be demonstrated either by dissection or during operation.

3. Experimentally, it can be shown that this sphincter, both by structure and function, protects the internal opening of the inguinal canal, and that section of its distinct nerve supply can and does produce atrophic dilatation of the internal abdominal ring.

4. Finally, that the importance of the internal inguinal sphincter in the etiology and management of inguinal hernia has, in the past, not been sufficiently appreciated.

In subsequent papers, we shall extend the report of our experimental work and discuss the relation of the inguinal sphincter to the treatment and operative management of inguinal hernia.

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THE SURGEON, THE PATIENT, AND THE CLINICAL DIAGNOSIS[1]

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TECHNIQUE commands almost the undivided attention of the younger surgeons. It has been said that as the bride in Milton's *Comus* was arrayed in chastity so the modern surgeon is arrayed in purity; hence, postoperative infections have well nigh disappeared.

The relative safety of operations, the dramatic features of a surgical procedure, the profound impression such a procedure has upon the patient's family and a portion of the community, and perhaps a lurking thought now and then among a few of a handsome fee, are luring younger surgeons into the exclusive path of technique.

In this age, technique and the laboratory are twins, dominant and insistent, and not unusually insolent. The bedside diagnostician must usually wait for the laboratory report and a favored diagnostic method without the laboratory study is surgical exploration. One who explores habitually is like Mr. Micawber seeking wealth and in momentary expectation of something turning up. Often, of course, exploration is demanded.

All emergencies are in the imperative mood and the present tense. To delay in order to obtain reports of the roentgenologist, who may not be accessible until some hour of the next day; of the hæmatologist and the bacteriologist, who may be on a journey, perhaps will mean an unnecessary fatality. I believe thoroughly in having *proper* laboratory studies made and by proper I mean when there is necessity and when there is time for them. It is true that at times a certainly accurate diagnosis, that is to say a diagnosis as to details, may be impossible without exploration or laboratory aids. It is possible, for instance, to diagnose dislocations, most fractures, cerebral compression, and many other conditions without laboratory or X-ray help. It is very difficult today to force the younger hospital surgeons to submit a diagnosis in a fracture until they have X-ray pictures. In the abdomen it may be quite impossible for the surgeon to be certain as to the exact nature of the lesion but he can be certain if there is an acute abdominal calamity. Again the X-ray is not always certain. This is the case in some fractures of the vertebræ, in some cases of gall stones, in stone in the ureter (which may be confused with a phlebolith or a calcified gland), in brain tumor (which in some doubtful cases excites a suspicion of a mental thunderstorm), and various other conditions. Nor is exploratory incision always a certain revealer of the truth. Its value depends largely on the experienced mind and the trained fingers of the operator. An inexperienced man may find nothing. Even an experienced man may at times be disappointed and find nothing to explain the situation.

The late Prof. J. Greig Smith, of University College, Bristol, said many wise things, among them the following:

"There is no doubt that a good deal of rashness and a certain amount of incompetence is sought to be concealed by the practice of exploratory incision. No incision ought to be simply exploratory and at the utmost it ought to be ultimately diagnostic in a case of extreme doubt and difficulty. . . . The exploratory incision of the skilled surgeon is extremely different from that of the tyro. Where the former may make a correct diagnosis in 99 out of 100 cases, the latter will fail over his tenth case; but he may not conclude that the justification of exploration is assured simply because he is in doubt in this case. Perhaps surgeons of large experience are somewhat to blame for so freely speaking of this tentative procedure as being frequently justifiable and necessary. What is justifiable in their experienced hands may not be so in the hands of the less experienced men. Before submitting our patient to what after all is a serious operation and a trying illness we ought again and again to return to the examination of the disease, read and re-read the exhaustive history and decide only after having done this. At different examinations the

[1]A number of years ago I presented a paper on this topic which was published in the *Pennsylvania Medical Journal*. The two articles are similar but not identical. In this paper, I quote myself at times. Such quotations may mean scantiness of mental resource but may also be due to profound conviction. If one believes, he must preach and repeat. The great Carlyle did so often, surely an insect may. J. C. DaC.

mind focuses its attention on different points and in different directions and each examination may give us new information."[1]

It is true that at times a complete and accurate diagnosis is impossible without an exploratory incision, but even in such a case a diagnosis can be made of an acute condition requiring immediate operation or of a chronic lesion requiring exploration for complete elucidation and treatment. The diagnosis is, of course, in every case the foundation of prognosis and treatment.

In striving to identify the condition, the surgeon should grasp all the physiological deviations and endeavor to visualize the anatomy of the region, the situation and extent of the lesion, and the picture of the pathological process. The surgeon himself must do this. The investigation is not to be delegated. The moral responsibility is on the surgeon in charge and he must not be lazily or carelessly indifferent to his responsibility and must not shrink from it because of fear or try to evade it because of doubt of himself. If he doubts himself he has chosen the wrong calling in life. To operate simply and only because a pathologist recommends it or a colleague advises it is an evasion of personal surgical responsibility due to laziness, indifference, ignorance, or moral cowardice. All recommendations from consultants and all laboratory reports must be studied and judged by the surgeon without a trace of prejudice. Such a grave personal responsibility cannot be laid upon the shoulders of another, no matter how broad those shoulders may be. Needless hesitation and delay in rendering a decision as to the diagnosis and treatment is abandonment of duty by the general when the battle has begun. His decision should be prompt and final. He may be in entire agreement with the consultant but he should never go solely upon the opinion of any other person, however prominent or persuasive that person may be.

The surgeon must see to it that his own shoulders bear the burden, for a surgeon's shoulders, by study and experience, in the words of the late Professor Joseph Pancoast, must become broad enough to bear the burden. This is a peremptory mandate and in it is a proof of the dignity of our calling. If one cannot or will not assume the full responsibility cast upon him by the personal trust of the patient, he belongs in some other calling and the trials and triumphs of the surgeon are not for him.

Of course, I do not mean that the surgeon should disregard the opinions of consultants. He should give such opinions full and respectful attention particularly if they do not agree with his own opinions. In every case when necessary and when there is time to obtain them, the reports from the chemical, pathological, and X-ray laboratories must be obtained; and these, with the opinion of consultations, will be studied and weighed before the final decision, which is and must be made by the surgeon in charge. A consultation is a great comfort and a decided support and it often furnishes extremely valuable suggestions. Responsibility is lessened when a colleague shares it. A family is soothed by a consultation and, should things go wrong, the acerbity of criticism is blunted. A surgical consultation resembles a council of war, but the surgeon may do as General Grant did after a council of war, proceed in accordance with his own opinions and against the advice of his consultants. In doing such a thing, however, remember Davy Crockett's words, "Be sure you are right and *then* go ahead."

A very young surgeon, laboring under mental growing pains, may oppose or actually resent a request for a consultation, believing that a family desire for one is an implied criticism of him or that a suggestion from him for a consultation would be regarded by the family as a confession of incompetence. A very ignorant man is apt to oppose a consultation because he fears exposure before a wise and learned man. Such a coward, it is true, guards himself but he does so by sacrificing his patient. A man dominated by vanity and obsessed by the conviction of his infallibility is sure to be contemptuous of the views of others and is certain to sacrifice patients to his obsessions and contempt. Such a man will not hear of a consultation. The more profound the knowledge and the greater the experience of a surgeon the stronger will

[1]Abdominal Surgery by Prof. J. Greig Smith.

be his conviction that often the best of men make mistakes and the gladder he will be to have a consultation. To insist on being the one to assume the responsibility and issue the final decision as to the diagnosis and treatment will at times bring embarrassing experiences. The surgeon may be obliged to disagree entirely with the attending physician as to the diagnosis, the treatment, or both. He may have traveled many miles expecting to operate and yet be obliged to decline to use the knife. Such a course may make medical enemies and lessen the number of referred cases, but it diminishes needless operations and saves lives. A surgeon should go to a case without any preconceived belief as to what the condition is. Preconception, prejudice, predominant ideas may prove fatal to accurate observation and reasoning, because the mind is all too apt to put the condition on the bed of Procrustes and stretch it to fit the ideas. It is all too easy to see the things we want to see or fear particularly to see. In order to make a diagnosis it is not enough to obtain from the patient one or two symptoms. The study should be complete. There should be a mental picture of the disease, a picture made up of the essential elements belonging to it. A clinical picture may be complete, it may lack one or two of the usual features or one or two elements may be exaggerated into seeming caricatures. The picture may be confused or blurred or something may be present which doesn't seem to belong there. Occasionally the picture consists only of a dim outline of a group of shadows.

Even the veriest tyro should comprehend those unusual cases in which the picture is complete. An exaggerated, blurred, or shadowy picture can be interpreted by no one but an expert and perhaps not by him. In not a few cases a positive diagnosis can be reached only by exploratory incision, by X-ray studies, by therapeutic tests, or by laboratory aids.

We have just pointed out that even an exploratory incision does not invariably make the diagnosis clear. Nevertheless, whereas comprehensive mathematical certainty as to the study of the entire organism is not possible, in most cases it is possible to make a correct diagnosis. It is seldom that a symptom could have but one possible cause, hence every possible cause of such a symptom must be thought of and sought for. *Elevated temperature* may be due to bacterial infection, auto-intoxication, hyperthyroidism, gout, uræmia, leukæmia, poisoning by illuminating gas or belladonna, sunstroke, malignant disease, Hodgkin's disease, syphilis or absorption of aseptic pyrogrenous material from an area of traumatism, injury of the brain or cervical cord, iodoform poisoning, or other things. As a solitary symptom, elevated temperature does not suffice for a diagnosis. The mode of onset, the conduct, the course, and the associations of the fever may be conclusive. In doubtful surgical cases, the rectal temperature is the only one upon which reliance is to be placed. In many cases of severe peritonitis, the axillary temperature may be found normal or subnormal and the rectal temperature much elevated. The wider the difference between these two records the worse the situation.

A question always to be asked is this: Did the disease begin with chilly sensations, a chill, or chills? Did a chill or chills arise without other symptoms? Were chills slight or severe, regular or irregular, and were they followed by sweats? In a multitude of diseases *pain* is a striking symptom. It is necessary to know its exact situation and if it has shifted from one region to another; if it developed with or as an addition to pain in another region. Its character (is it aching, lancinating, pulsating, shooting, or dull); if it came on suddenly or gradually; if it was at first trivial and became progressively worse. We ask if it is intense or moderate. Is it continuous and steady, continuous with exacerbations or remissions, or is it intermittent? Is its position fixed or shifting? Does it follow a nerve trajectory? Does it arise only on motion or pressure or is it present even when at rest? Is it accompanied by tenderness or rigidity? Is there nausea and does vomiting take place? Is the temperature elevated? Is the pulse accelerated and what is its character? In determining the exact situation of pain, have the patient place his hand or a finger upon the spot so as to avoid a mistake.

Make every effort to determine which organ, viscus, or structure is the seat of pain. The sudden cessation of violent pain, if not obtained by opiates, may mean the relief of a pathological condition, for instance, the release of strangulated hernia or a twist of the sigmoid, but it may be a most ominous sign, significant of gangrene, as in certain cases of appendicitis or intestinal obstruction.

In estimating the reality, persistence, and intensity of pain, study the *face*. For instance, in acute peritonitis, the face is set and contorted. The upper lip is raised, exposing some of the teeth. There is an expression of the greatest anxiety, the tips of the ears, the lips, and even the rest of the face may be cyanosed. Fothergill pointed out that in pain, not due to peritonitis, there is a marked twitching of the muscles about the eyes and the upper lip. When a person has been a long sufferer from pain there is a heaviness and fullness about the eyes, the brows are contracted, the angles of the mouth droop, and the expression is utterly weary and hopeless. The expression of the face in children is extremely important. Professor Hobart A. Hare[1] says: "It is not uncommon for an expression to pass over the face of a child while sleeping when suffering from pain, which begins with a smile and ends with a drawing-in of the corners of the mouth, an expression somewhat like that seen on the face of a waking child when it seems to be in doubt as whether to laugh or cry. Whether asleep or awake a child in pain, if not crying, has a pinched look about its nose and mouth and sometimes some idea of the seat of pain may be gained by the part of the face which is drawn. When pain is in the head, the forehead is apt to be wrinkled into a frown; if the nose is pinched and drawn, it is said to show that the pain is in the chest; and if the upper lip is raised, the pain is probably felt in the belly."

The face, of course, may indicate many things besides pain, for instance, alcoholism, the opium habit, tetanus, strychnine poisoning, tic doloreux, jaundice (the white of the eye and skin being yellow), anæmia, cachexia of cancer, hyperthyroidism, hypothyroidism, menstruation, œdema, Bright's disease, mouth-breathing from adenoids, acromegaly, paralysis of the facial nerve, etc. In shock, there is deadly pallor; in most cases of advancing peritonitis, cyanosis—in poisoning by coal tar products, cyanosis—in exhausting diseases, pallor and emaciation. Cancer imparts a straw yellow color to the skin, contrasting with the pearly white conjunctivæ. This contrast at once indicates the diagnosis from jaundice. In lobar pneumonia, the face is flushed and the flush is usually accentuated on one cheek. In cardiac disease there may be pallor or cyanosis with distended nostrils and gasping respiration. In advanced sepsis the dull and apathetic face is ashy pale or dusky, the lips mutter in delirium, and the teeth are covered with sordes. Bodily weakness, marked loss of flesh, rapid pulse, polyuria, hæmaturia, disorder of the reflexes, diarrhœa, spitting of blood, cough, malæna, constipation, ascites, indigestion, nausea, vomiting, headache, motor paralysis, analgesia, hæmorrhoids, may be due to various causes.

The mode of onset, character, severity, duration of the disease, and the apparent cause help us to mark the significance of any of the above symptoms.

An isolated symptom is very seldom as valuable diagnostically as a symptom group. Pathognomonic symptoms are extremely unusual. The disease may fail to exhibit some symptoms regarded as belonging to it. Such an absence constitutes a negative symptom.

A victim of brain tumor may not have choking of the optic discs (for instance in glioma, in slow growing tumor, and, for a considerable time, in tumor of the pituitary gland). A patient with cancer of the stomach may have no pain. An individual laboring under pyogenic infection may have no elevation of temperature, and a man with peritonitis may have a slow pulse. Leucocytosis may be absent when pus is present (if the defenses of the system are failing or if the pus is encompassed by adhesions). A negative Wassermann reaction is not uncommon in tertiary syphilis and a positive reaction may only be developed after the inauguration of specific treatment. In appendicitis, if the

[1]Symptoms in the Diagnosis of Diseases.

appendix is in the pelvis, there may be for a time no abdominal tenderness or rigidity. Abdominal rigidity may be absent if the appendix is tucked up back of or outside of the cæcum, a condition the late Dr. Joseph Price compared to a dog with his tail between his legs. Rigidity will be absent in appendicitis if the belly is much relaxed from repeated pregnancies, if considerable morphia has been given, and perhaps if an ice bag has been employed.

Hare points out that valvular heart disease may produce no symptoms until the circulation is failing and that in a lung that is engorged there may be no râles. A negative symptom is often very important and may suggest failure of physiological reaction, acquired immunity, a complication, the previous administration of a drug, or the simultaneous existence of another disease.

Grave myocardial failure may cause the disappearance of heart murmurs. Morphine may arrest pain. The ice bag lessens abdominal inflammatory pain. Gangrene halts pain. Sometimes a clinical picture contains more than seems to belong to it and perhaps something thought to belong to a different disease. Such a condition is due to a complication, a predisposition, a drug habit, the previous administration of a drug by a physician, or the simultaneous existence of another disease. When an inflamed appendix is adherent to the ureter, there may be hæmaturia and pain like that of renal colic, although, of course, hæmaturia in a case of appendicitis may be due purely to nephritis. In the first form of hæmaturia, the blood comes from only one ureter, in the second form it comes from both. Such determination can be made only by means of the cystoscope. A patient who has been anæsthetized by ether or chloroform, but particularly by chloroform, may develop jaundice or acid intoxication. Abdominal operation even when carried out in a region well away from the stomach may be followed by vomiting of blood. When a man with piles develops intestinal obstruction, we know that the obstruction is not due to the piles but is due to some lesion, probably cancer, higher up in the intestinal canal. Obstinate insomnia during the course of a disease or an injury, if not due to pain or a psychoneurosis, demands an inquiry as to whether the patient is an alcoholic, or a habitué of morphia or heroin who has been deprived of his usual doses. Some persons are so strongly predisposed to delirium that it arises from very trivial elevations of temperature. Delirium from slight fever is common in children and in the aged.

Just as certain persons resemble each other, so may certain diseases. Typhoid fever with severe abdominal pain may resemble acute appendicitis. Chronic appendicitis, duodenal ulcer, gall-bladder disease, gastric ulcer, chronic pancreatitis may resemble each other. Acute hæmorrhagic pancreatitis has been mistaken for intestinal obstruction, although the horrible pain of the former condition, as pointed out by Lord Moynihan, should prevent the mistake. The resemblance may be a mere suggestion of a likeness. It may be first more definite but on investigation will be found to lack certain features. The resemblance may be very strong, in fact, it may be so close as to lead to the gravest diagnostic uncertainty. A disease unfortunately without any usual resemblance to another disease may take on such a resemblance for a brief time. Pleural pneumonia does not usually bear any resemblance to acute appendicitis, but pleural pneumonia of the right lower lobe may be thought for a time in the beginning to be appendicitis because of the abdominal pain, tenderness, and rigidity which may occur for a time in pneumonia and may lead to a diagnosis being made of acute appendicitis.

Sometimes a disease acts like an ingenious criminal and disguises itself so as to imitate another disease or at least so as to escape recognition entirely. Just as a person may have a different appearance at different times, so may a disease at different times and also in different persons. Unfortunately, there is no Bertillon system of measurements and there are no finger prints to aid us in recognizing disease. Nevertheless, despite complications, disguises, and resemblances, it is usually possible to identify the nature and seat of the disease.

Sometimes a doubtful diagnosis may be cleared up by the state of the consciousness, the occurrence of fits and their character, the posture of the patient in bed, or his gait while walking. Even the odor of the breath may help.

Failure in diagnosis makes symptomatic treatment the only resource and symptomatic treatment is haphazard, indefinite, and frequently hazardous. In fever from an infection, what good could possibly come from lowering the temperature with antipyretic drugs? Who can deny that fever is beneficial by destroying the bacteria or toxins? By lowering temperature great harm may be done. It is as true of sepsis as it is of scarlet fever that the most dangerous cases are those with a low temperature.

A correct diagnosis is essential for correct treatment. Diagnosis is in part a science and in part an art. As science it employs all known facts and accepted principles in the solution of a problem. It is in part an art because the surgeon must know how to observe, how to examine, how to utilize facts, and how to employ principles. Diagnosis possesses enormous interest and is of vital importance. It is the greatest and most serious of all games, a game in which limb or life is frequently the stake. Its problems absorb the trained seeker for surgical truth as the problems of an obscure crime absorb the trained criminal investigator. On the proper solution of the puzzle the future or even the life of the patient may depend. Diagnosis is no job for a dull, callous, or lazy man.

In the making of a diagnosis the history must be developed and all morbid phenomena must be observed with accuracy. The history includes the history of the family, of the person, and of the disease. Heredity may be of interest and importance—as in developmental defects, suspected syphilis of early life, neoplasms, tuberculous disease, hæmophilia, hereditary telangiectasis, mental disease, spontaneous fractures, etc. The personal history is of extreme importance. Is there a history of syphilis, tuberculosis, cancer, antecedent febrile trouble, etc.? What are the habits of the patient as to drugs, tobacco, alcohol, etc.? In what way did the disease begin and where did it seem to be located? What were the symptoms and what has been its course? To what does the patient attribute the condition? Is it continuous, remittent, or intermittent? Is it getting better or worse? What has been done for it and by whom? The latter is decidedly an important query. It is wise to check up on the patient's statements by obtaining a statement, if possible, from the family physician, but if that is impossible from a member of the family or a friend. In a young child our only source of information is the physician, a nurse, or a member of the family. If the patient is mentally affected, we must rely for his history on others rather than on himself.

The occupation of the patient may be the key to the diagnosis. For instance, in the keratoses of a radiologist; housemaid's knee; miner's elbow; arsenic workers' neuritis; phosphorous workers' necrosis; painter's paralysis; chauffeur's fracture; mercury workers' salivation; anthrax as seen in the wool sorter, the worker in hides or the junk dealer; the chrome sores of leather workers, etc. Even his sport should be considered. For instance, in the buttock bursa of the rower, lawn tennis arm, rider's knee, etc.

If a surgeon would question a patient well he must use as much skill as a lawyer requires to question a witness. Truths may have to be fished from floods of loquacity or dragged from depths of taciturnity. To listen for a moment or two when a patient is being questioned, will enable us to determine not only the caliber and equipment of the patient, but also of the questioner. Haphazard questions are useless and often harmful. Questioning must be purposive, systematic, and logical. Repetitions are needless and often irritating to the patient. Sometimes it is well to be alone with the patient and to be very tactful when asking certain questions, for instance, as to a drug habit, masturbation, sexual perversion, alcoholism, or venereal disease. A sudden fool question stupidly propounded may result in violent rage, sullen silence, evasion, or a lie. One should not ask a clergyman when he last had gonorrhœa, or an

unmarried girl how long since she has been pregnant. The clergyman may be guilty and the girl unfortunate but a gentler examination would have been more apt to have elicited truth. Lies are common. As Prince Hal says: "Some lies are as gross as mountains, open, palpable," but even the ablest diagnostician may be deceived by lies.

A paranoiac, a melancholiac, a paretic, or a victim of cerebral syphilis may make absurd statements, varying them and altering them under questioning. Such fabrications are delusional. A man who has had a head injury perhaps long before may be deliberately untruthful or he may exaggerate unconsciously, mistaking his imaginings for realities, as in Korsakoff's psychosis. At times lies are difficult to detect and at times detection is impossible. Litigants often lie, so do the victims of venereal disease, so do pregnant girls, so do masturbators, so do menstruating women and women going through the menopause. Hysterical women, opium eaters, cocain users, heroin addicts, alcoholic inebriates, and epileptics lie freely and often needlessly. Habitual criminals are habitual liars and even in illness are prone to exaggerate and pervert. Some lies are prompted by the wish to become important or by the desire for sympathy. For instance, those of hysterical women who lie from an egotism which leads to the assumption of a leading a heroic or a martyr's rôle. A not uncommon cause of falsehood, particularly among women, is the desire to worry or injure a person. A man pretended desperate sickness in order to punish a wife for nagging him. Another man pretended to have received an internal injury in order to provoke the censure of a hated foreman. Children are apt to tell the most amazing untruths. An old man's statements are often unreliable particularly because his memory for recent events may be much confused. I would hardly go so far as Falstaff who said "Old men are addicted to this vice of lying." Hypochondriacs invent diseases and morbidly magnify real phenomena. The hysterical patient imitates unconsciously and so deceives. The boaster lies about his condition and his case in expectation of receiving a reputation for fortitude and heroism. A man who fell down when drunk claimed to have been injured rescuing a child from in front of an automobile and had the police searching for the child and the car. Neurotics are very apt to make false statements. They may misinterpret real sensations or invent pains and disabilities. A child may lie to avoid school or punishment and many persons lie to avoid work, domestic discord, jury duty, in order to get in a hospital to collect accident or disability insurance or to obtain money by a suit at law. The trained army surgeon and the experienced naval surgeon are always on the watch for shirkers and become remarkably skillful in detecting them. Some patients lie to avoid a subpœna in a court case or to cover up drunkenness. Sometimes the family lies. They may do so in an injury involving litigation. They are almost certain to do so to cover up domestic trouble. They will usually do so in regard to epilepsy and mental disease. The supposed disgrace of insanity and epilepsy leads to absurd or shadowy claims of causal head injury in the far past. A statement which is part a lie is even more confusing than a complete lie.

"A lie which is all a lie may be met and
fought with outright
But a lie which is part a truth is a harder
matter to fight."

Observation, accurate and complete, is imperative. This requires a master's knowledge of disease and injuries, interest in the problem, close observation, knowing how to observe and question, and the ability to obtain clear registrations upon the memory. Accurate notes must be taken down at the time of the examination.

In Sterne's *Tristram Shandy* we find set forth a threefold cause for "obscurity and confusion" in a man's mind. "Dull organs, dear sir, in the first place. Secondly, a slight and transient impression made by the object and the said organs are dull, and thirdly, a memory like unto a sieve not able to retain what it has received." Dull organs in a patient or a doctor constitute formidable obstacles. "Against stupidity even the gods fight in vain."

Bedside notes constitute a record which is a lasting memory and may be most important in the scientific and at times in the medico-legal aspect of the case.

Some men have an aptitude for the art of observation. Some have not. But no man is an accurate observer by instinct. He can become an accurate observer only by long training. Maudsley, in his brilliant and learned *Pathology of Mind*, says: "True observation comes not by instinct but is gained painfully by training."

A person with an aptitude for observation can train the power more quickly and to a higher degree than can one whose observation reactions are dull. One observes most easily and accurately those things in which he is interested and which he knows best. Suppose a group of persons were thrown together by accident. Each one studies the other. The shoemaker at once notices the shoes, the tailor the clothes, the barber the hair, the dentist the teeth, and the hatter the hats. "Lazarus has rightly called to mind what is told by the pious Charles von Schmidt concerning the clever boy who lies under a tree and recognizes the condition of every passer-by according to what he says, which means what he sees. 'What fine lumber,' 'Good morning, carpenter.' . . . 'What magnificent bark,' 'Good morning, tanner.' . . . What beautiful branches,' 'Good morning, painter.'" (See *Criminal Psychology* by Hans Gross.) This significant story shows how effective is observation.

A competent specialist will at once observe phenomena which are in his line, which a general practitioner or a specialist in another line may not note at all.

Few men are universal observers as was Joseph Bell, of Edinburgh. Because a man observes quickly things relating to his own calling is no sign that he will be adept in observing things relating to other callings.

A woman is greatly interested in dress and a glance of but a moment enables her to describe accurately every visible garment worn by another woman; and yet she may not be able to describe intelligently anything else in life. A woman will give a description of the guests at a wedding and of the dress each one wore so comprehensively and detailed as to seem uncanny but then a woman's real profession is matrimony and dress is a powerful aid to matrimony, hence her interest in dress and her success in describing it.

A person not interested in diagnosis is certain to be a poor diagnostician. Many persons are devoid absolutely of the power of correct observation. They go through life seeing nothing fully, accurately, or in detail; they know things only by their salient features and many things they do not really see at all. Such a person is a very unreliable witness in court, is often sure that what did not happen did happen and uncertain as to what he did see. He would make a better clerk than he would a surgeon.

Many sensations are never registered or rather are faintly registered and do not become impressions in the brain. Slight impressions do not give rise to ideas and cannot be recalled as memories. We have really observed when impressions have been registered and have given rise to ideas.

During a long period a person may fail really to see things with which he is in daily contact. Edridge Green in his treatise on *Memory* gives an example of such failure. He passed to his students the leaf of a tree. Not one could identify it. It was the leaf of the common plane tree of the streets of London. Every student had passed plane trees hundreds of times but no student had truly observed them.

The surgeon must carefully train and cultivate the power of observation. In most men the power may be greatly enhanced by constant exercise. Robert Houdin, the famous French prestidigitateur, is an example of one who trained his powers of observation so highly that they came to constitute a faculty which acted with marvelous speed and precision. While walking in the street he could, after a simple passing glance into a show window, name and describe nearly everything exposed there for sale. In this we see a wonderful combination of close attention, rapid observation, vivid registration, and faultless memory.

Few men can become Houdins but almost any man, unless absolutely stupid, utterly

careless, or extremely lazy, may become a reasonably good observer. Every good diagnostician is a careful observer though some are better than others. A really good clinician sees at a glance the obvious things that a lesser man descries only after prolonged study or perhaps does not discover at all. A considerable part of the education of a child should be the development of the powers of observation. Children are natural observers but with the general idiocy which characterizes so many of the proceedings of modern life we carefully strive to take out of them this valuable faculty. In modern education observation should occupy a great place, even if so placing it makes necessary the sacrifice of the teaching of many facts and of some of the narrow specialties.

Our great aims should be how to observe, how to visualize the disease and its seat, how to study, what to study, and how to think. Most children visualize naturally. Tell them a story and they see the gnomes and the giants, the fairies and the goblins. We are doing our best to take this great faculty out of them.

The real method of observation was set forth by Huxley in 1880. He called it the method of Zadig. Zadig was Voltaire's philosopher who observed many apparently trivial things and from such indications reached conclusions so striking and unexpected as to cause his hearers to attribute them to supernatural influence or to roguery.

In modern literature we find a similar method employed by Edgar Allen Poe's *Dupin* and by Sir Arthur Conan Doyle's *Sherlock Holmes*. Those who read Dumas will remember how D'Artagnan searched the field in which the duel had been fought and from a series of small indications gave to the King a description of exactly what happened there.

If one observes inaccurately or incompletely he will never make a correct diagnosis unless he blunders on it or makes a successful guess.

Benjamin Franklin said: "Want of care does more damage than want of knowledge." Sir William Gull said: "We make more mistakes from not looking than from not knowing." A so-called diagnosis by intuition is simply a jump to a conclusion after observing a symptom or a symptom group. It is seldom correct, and I pointed out years ago that it is usually only a rapid method of reaching a wrong conclusion.

As Professor Stengel has said: "An occasional apparent hit by this method may do great harm to a group of assistants or a class of students by leading them to believe that the more toilsome method is not necessary. The latter plan is less dramatic but far and away more certain and valuable."

Some intelligent men never become good diagnosticians. The incapacity may be due to deficient training, lack of interest, laziness, the use of poor methods, unwillingness to take pains, dominance of a temperament, the riding of a hobby, chasing the elusive will o' the wisp of imperfect and unsound knowledge.

Men are prone to think they see the things which they expect to see, wish to see, or fear to see.

A predominant idea may exclude or blur the optical images which, were they admitted to consciousness, would give rise to ideas which would be registered as memories. Even the things seen may be seen incorrectly or incompletely, and things which are not there may be described. Similarities are recognized more certainly than differences unless the differences are very conspicuous.

Reid in *Principles of Heredity* says: "As is well known we are apt to overlook considerable differences especially in unfamiliar forms unless our powers of observation have been trained by experience. Thus we are able to detect most differences between people of our race, but Chinamen are much alike to us. The ordinary man hardly knows one sheep from another—the shepherd knows every member of his flock."

Fashion and custom in surgery may control a diagnostic decision. One is apt to find many instances of a disease which is the fashion. We know how often appendicitis is diagnosticated when it does not exist, and how commonly nephroptosis is pointed out as a cause of neurasthenia when in reality there is no movability of the kidney beyond normal.

Some who love paradoxes are prone to have contempt for the probable, they always seek for the improbable, the unusual, and the bizarre.

A neurotic surgeon is particularly prone to obsessions, and enthusiasm is as dangerous as prejudice. A good portion of skepticism plus reasonable accessibility to new impressions is the proper mental atmosphere which favors clear judgment. Some men labor under morbid doubt. Such a man says, "It may be this or it might be that." He brings little comfort to a family physician and none at all to a patient. A surgeon always strives to form a definite opinion (although to do so may be impossible) and if he forms one he will, of course, always have the moral courage to state it.

A diagnostician may fail because of ignorance, stupidity, inability to concentrate the attention, abject subservience to authority, love of new ways and new things, unreasonable worship of old ways and old things, inability to recognize differences and to reject apparent similarities, mental dishonesty, impairment of sight, smell, hearing, or touch, or the use of improper methods. A man who is usually an excellent observer may at times become a poor one. Such a failure may be due to illness, a sleepless night, tire, worry, carelessness which is a child of overconfidence, preoccupation, dropping into routine (as busy dispensary men sometimes do) or attempting to make a brilliant "intuitive diagnosis." Bodily tire and mental fatigue make close attention and observation all but impossible.

Logic is described by Sheil as the science of evidence. In order to reason correctly a logical mind is a necessary instrument. It is necessary for the diagnostician to reason correctly on the information furnished by the history and by the examination. The surgeon must analyze, measure, compare values, separate the casual from the causal, the transitory from the permanent, that which is guessed from that which is known. He must cast out absolutely what Junius called "false facts." Surgical sea serpents and base scientific coin are to be rejected. In reaching a conclusion the surgeon calls upon the memories of his reading and his personal experience in order to compare them, contrasting them with the case which is being studied. Even a good observer will make great mistakes if he is devoid of the logical faculty. Even the best of logicians will make miserable failures if he doesn't possess or doesn't use the faculty of observation.

James Berry in his admirable *Manual of Surgical Diagnosis* says: "Surgical diagnosis ought not to consist, as some students imagine that it does, in the mere fitting of a name to a diseased condition. It should be much more than this, it should aim in ascertaining as exactly as possible and in what respect and to what extent the patient's condition deviates from that of perfect health. In other words, it should comprise not only the nomenclature of the disease but also the degree and extent of that disease."

When one endeavors to practice surgery as advised in this article, he assumes a great responsibility, and how great a responsibility it is. Vast is the responsibility borne by a conscientious practitioner of medicine or surgery. A very great writer says: "One can fancy how awful the responsibility must be to a conscientious man, how cruel the feeling that he has given the wrong remedy or thought it may have been possible to do better, how harassing the sympathy of the survivors if the case is unfortunate, how immense the delight of victory." These solemn words as the reader knows were written by William Makepeace Thackeray.

CLINICAL SURGERY

FROM THE SURGICAL CLINIC OF THE LONDON HOSPITAL

RECONSTRUCTION OF THE COMMON BILE DUCT

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RECONSTRUCTION of the common bile duct, by which is meant an attempt to fashion an entirely new lower portion of the duct and its opening as distinct from operations of end-to-end suture, may be required after complete division of the duct, either accidentally or by design, or when the duct is still present but shows an irremovable obstruction.

Accidental division. The operation of cholecystectomy is often fraught with considerable difficulties, and the more frequently it is undertaken the more does the operator realize how easy it is to mistake a portion of the common duct for the cystic duct and to divide it. Anatomical and pathological abnormalities greatly enhance this danger, as shown in Figures 1 to 4, and there is no doubt that accidents of this sort are much more frequent than is generally believed. Of my own series of 24 reconstructions, 8 were due to the fact that the common duct had been accidentally divided at a previous operation and often by surgeons who were well skilled in operative technique. These and other reported cases give, however, no true indication of the frequency of the lesion, for many do not survive the accident, while others, in whom the accident had been recognized at once, have recovered after an immediate end-to-end suture which has correctly been chosen because success is more likely to follow the suture of normal tissues than the plastic procedure undertaken on inflamed and scarred material.

Should the injury be overlooked or the primary suture fail, the duct may become obstructed at the site, in which case the portion above will become much dilated, a change which will make the technical steps of the reconstruction operation much easier, but at the same time the patient will become deeply jaundiced, and if left for any length of time will suffer from hepatic insufficiency so that the operative risks will be greatly increased. More commonly, however, bile is discharged from the wound, and after a short time a well defined sinus is left from which all the bile escapes. The upper part of the duct will then be collapsed, and in long-standing cases may be extremely difficult to find. The patient, however, will not be suffering from jaundice and will be in a much better general condition, and thus better able to withstand the stress of a prolonged operation. In either case the portion of the duct below the injury will after a few weeks become so collapsed and involved in scar that it is very rarely recognized.

Operative resection of a portion of the duct. A gap may be designedly made in the course of the duct, either because there is a congenital absence of the cystic duct, in which case the hepatic and common ducts open separately into the gall bladder and thus are not in continuity after a cholecystectomy, or because in a relatively few suitable cases a benign or carcinomatous stricture is present and an attempt can be made to remove it. As a rule but few of these cases require an operation by the reconstructive method, for generally the primary procedure is so designed that an immediate end-to-end suture is possible. Occasionally so large a portion of the duct has to be removed that an approximation is impossible even after free mobilization of the duodenum. In such cases a reconstruction may be essential.

In these two groups, which include the greater number and the more important cases, the reconstruction operation is undertaken by the terminal method.

Irremovable obstruction in continuity. From the point of view of surgical technique, these cases may be considered in three groups. In the first variety there is disease of the gall bladder, such as cholecystitis and gall stones, which is associated with a mild degree of obstruction of the common duct from an associated chronic pancreatitis. This obstruction is insufficient to have led to a dilatation of the common duct, although it may be

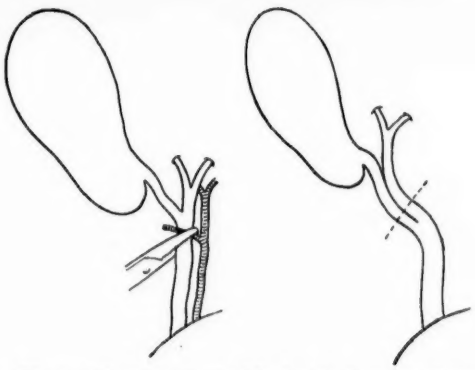

Fig. 1. Injury of common bile duct in clamping abnormal cystic artery.
Fig. 2. Division of common bile duct with an adherent cystic duct.

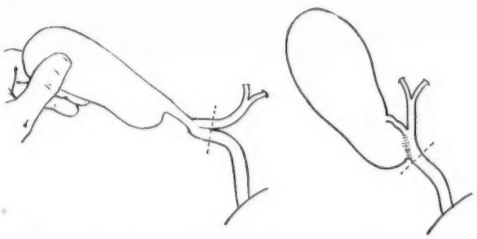

Fig. 3. Tension upon gall bladder causing a loop of the common bile duct which is divided in mistake for the cystic duct.
Fig. 4. Common bile duct adherent to Hartmann's pouch and mistaken for cystic duct.

difficult or impossible to pass a probe into the duodenum. If the surgeon be satisfied with an incomplete exploration of the duct and proceeds to remove the diseased gall bladder, the obstruction of the head of the pancreas may be sufficient to prevent closure of the stump of the cystic or the opening of the common duct, so that a permanent biliary fistula forms and the case then becomes identical with one in which the common duct has been divided.

In the next group, in which there is a complete obstruction, the condition is as a rule made evident owing to the fact that there is profound jaundice, a dilated gall bladder containing thick tenacious bile, and a dilated common duct. In some long-continued cases, however, the liver completely fails in its function so that both the common bile duct and the gall bladder are filled with an almost colorless bile. The appearance of this material in the gall bladder may suggest that there is cystic duct obstruction, and if the common duct be opened to settle the diagnosis a persistent biliary fistula may form even after the performance of a cholecystenterostomy. In this variety the condition, after a short time, will also simulate an accidental division, but the operative procedures will be complicated by the presence of a cholecystenterostomy. In the last group there may be a combination of lesions which will give rise to a considerable amount of difficulty in diagnosis and treatment. For instance, carcinoma of the common duct may occasionally be associated with carcinoma of the gall bladder or with calculi in the bladder, or a chronic pancreatitis may be associated with an acute cholecystitis, while yet again a small growth may be found at the junction of all three ducts. For one or other of these reasons it may be impossible to utilize the gall bladder in the performance of a cholecystenterostomy. If the common duct is much dilated, a lateral cholecystenterostomy by methods of simple suture may be feasible, but if it is only of moderate size such a union may be difficult, and a reconstruction of the lower portion of the duct will probably allow a more satisfactory passage of the bile. A similar technique might be required in the rare condition in which a fibrous stricture has followed cholecystectomy, but in such cases it is probable that the common duct will be sufficiently dilated for the performance of a lateral choledochoenterostomy. In all this group, reconstruction will probably be of the lateral type, but since it is generally performed at the time of the first operation it is likely to be associated with fewer difficulties.

DANGEROUS COMPLICATIONS

The chief difficulty which will arise in the performance of the terminal reconstruction is that the duct may have been divided very high up. This is especially likely to be the case when the common duct has been accidentally divided in mistake for the cystic duct, for after the first division below the cystic duct the dissection is carried upward, and as the gall bladder is removed the common hepatic or the individual hepatic ducts are often divided in the hilum of the liver. In some of my cases so high was the division that it was only after a very prolonged dissection indeed that two small constricted openings were found situated in a mass of scar tissue far up in the hilum. Under such conditions any operation becomes almost impossible, for no portion of normal proximal duct can be obtained with which to make an anastomosis. In any of the secondary operations the dissection will always be prolonged and tedious. There are not only the adhesions arising from the

first operation but there has usually been a considerable amount of inflammatory change owing to the passage of bile. The duodenum may be firmly adherent to the under surface of the liver, and the gall bladder has usually been removed so that there are few if any anatomical landmarks which will help the surgeon to determine the level of the individual structures. The remaining difficulty lies in the fact that these patients are as a rule very poor operative risks. In some cases there has been not only a preliminary operation but several attempts to reconstruct the duct. In addition there has been either the wearying effect of a long-continued biliary discharge or a profound jaundice with a varying degree of hepatic insufficiency.

PREPARATION FOR OPERATION

All these enfeebled patients should have a period of complete rest in bed and careful preparation. If there has been marked jaundice a course of calcium medication may be necessary to lessen the danger of hæmorrhage. In other cases the patient should be admitted to the hospital at least 48 hours before the operation is undertaken. If there is a biliary fistula this should be carefully cleaned, the patient be placed on a light diet, and the bowels freely opened but not unduly purged. No solid food is given in the last 18 hours before the operation, but 3 or 4 hours before, a few ounces of meat broth are administered and a hypodermic injection of $^1/_{100}$ grain atropine is given ¾ hour before the operation is due.

TECHNICAL STEPS OF THE OPERATION

Anæsthesia may be induced either with ether or with local infiltration methods. Chloroform should be avoided, for so often the liver is functioning poorly. My own preference is for open ether or warm ether vapor. With a skilled anæsthetist, this method will give a most satisfactory anæsthesia producing no ill after-effects, and not only does its induction occupy a shorter period than the local anæsthetic, but it has the benefit of producing unconsciousness in the patient. Access is best obtained by a long right pararectal incision. Frequently this is carried out in the form of an ellipse so as to excise the old scar and to encircle any biliary sinus. It should be carried well up the angle between the xiphisternum and costal margin, but very rarely indeed have I found it necessary to combine it with an oblique incision of the upper end. If the patient has the upper abdomen thrown forward by a sandbag or the raised cross-bar of the operating table a long pararectal incision will give the most ideal access, and it is my incision of choice for all operations upon the stomach, duodenum, gall bladder, and pancreas.

The anterior sheath having been divided in the whole length of the incision, the right rectus is displaced outward. On account of the previous operation this may take a little time, as the muscle is now adherent and does not strip readily from its sheath. The posterior sheath and peritoneum should be divided in the upper part of the incision, for not infrequently the omentum, colon, or stomach may be adherent to the anterior wall. Such adhesions are less frequently found over the surface of the liver, but if present and the incision be accidentally made too deep, little or no harm will result in making a small nick into the liver, whereas an incision into one of the hollow viscera may occupy considerable time in its repair. When an opening has been made in the upper part of the peritoneal cavity, a finger is inserted and the extent of the adhesions determined. The peritoneum can then be opened to the lowest point of the incision as the adhesions are gradually freed. It is essential, before any attempt be made to locate the common bile duct, that the anterior layer of peritoneum be freed from adhesions and that the liver, colon, stomach, and duodenum be isolated and identified. In the cases of irremovable obstruction no difficulty will be found in recognizing the dilated gall bladder and the common bile duct, but in the difficult cases where the gall bladder has been removed, the duodenum will generally be found adherent to the under surface of the liver. An automatic retractor should be inserted so as to separate the two sides of the incision widely, and the stomach and colon should be carefully held aside with gauze packs. The duodenum is now most carefully and gently dissected from the under surface of the liver, for it is the upper border of the first part of the duodenum which will be the only safe landmark to the surgeon. As soon as possible a finger should be inserted into the foramen of Winslow, and by the lifting forward of the anterior border of the gastrohepatic omentum the portal vein and hepatic artery will be elevated. If there is a biliary sinus, a probe may sometimes be passed up it into the common bile duct, and if there is complete obstruction, the dilated upper end of the common duct may become visible after a little dissection. It is, however, in the recognition and isolation of the structures in the gastrohepatic omentum that so much time may be occupied. The fibrous tissue is often dense and adherent, and the opening of the sinus may be so small that it is recognized with great difficulty—a difficulty which may be

Fig. 5. Flap has been cut on the anterior surface of the duodenum.

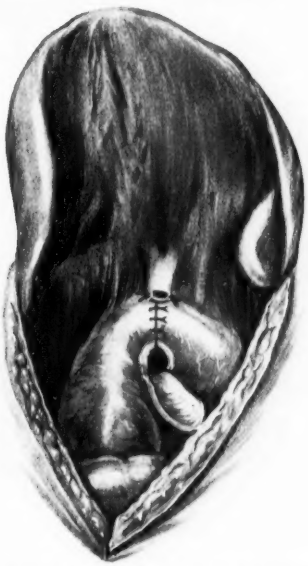

Fig. 6. Upper portion of opening in duodenum is sutured to leave opening of same caliber as divided duct.

increased by the fact that under the anæsthetic the secretion of bile often appears to be in abeyance so that none escapes from the opening. The dissection must, however, be most carefully continued until the surgeon is confident either that he has found the opening above into the divided duct or that he can recognize the dilated duct. The portal vein may sometimes in this difficult resection resemble a dilated duct, and if the surgeon is at all uncertain he may insert a small hypodermic needle mounted on a syringe, and the withdrawal of either blood or bile will at once make clear to him whether he is dealing with the duct or the vein. With an irremovable obstruction, the dilated duct should be freed as low as possible so that the anastomosis can be performed close to the duodenum. If there is a benign or carcinomatous stricture, which has to be removed, this must be carefully freed so that it can be recognized in its full extent. These preliminary steps in the recognition of the nature or site of the lesion having been performed, the surgeon will proceed to carry out the reconstruction. If the obstruction is irremovable, and a cholecystenterostomy is not possible, this will be of the lateral type, whereas if the duct has been divided it will be terminal.

Terminal reconstruction. If in the dissection the duodenum has not been freely mobilized, the lateral peritoneal folds should be divided and the duodenum mobilized until it can be drawn up without tension to the hilum of the liver. In some cases in which the remaining portion of the common bile duct is sufficiently long, this mobilization may permit of direct implantation of the duct into the duodenum, a method which should be carried out wherever possible, but in the majority the remaining portion of the duct is of insufficient length to permit this, and a true reconstruction will have to be performed. A catgut suture is passed through the upper border of the duodenum and through the posterior wall of the divided duct and tied, the two structures being thereby drawn as nearly into apposition as possible. The union between the divided duct and the upper border of the duodenum is completed either with a continuous or with a few interrupted sutures. A flap is now cut on the anterior surface of the duodenum in such a way that the resulting opening in the duodenum is immediately opposite the cut end of the duct and the flap is turned downward (Fig. 5). The upper portion of the opening of the duodenum is sutured with chromic gut until the opening that is left below is of the same caliber as the divided duct (Fig. 6). A piece of tube about 1½ inches in length and of the largest possible diameter is inserted into the divided duct and sutured in place with one stitch of plain catgut. Its lower end is

Fig. 7. A tube 1½ inches long and of largest possible diameter is inserted into divided duct and sutured into place with one stitch.

now inserted into the opening in the duodenum and the flap turned upward over it. In the upper portion the flap is sutured carefully to the duct and laterally to the anterior wall of the duodenum which lies behind the tube (Fig. 8). By this means a free but valvular opening is made and the new portion of the duct is formed by the flap of the duodenum, which is lined with mucosa accustomed to the passage of bile. A tube is inserted down to the junction in case there should be any leakage, and the wound is then closed. It is this type of operation which is most frequently required. It will be found in practice that once the proximal end of the duct has been recognized and isolated, the operation is simple to perform, and a new duct of practically any length can be fashioned from the duodenal wall.

Lateral reconstruction. The steps of this operation are very similar. A lateral opening is made into the dilated duct as close to the duodenum as possible. If there is any gap between the opening and the duodenum, the wall of this latter structure is drawn upward and sutured to the duct immediately below the opening. A tube is inserted into the duct and sutured in position with plain catgut. A flap is then made in the duodenum in the usual way and sutured round the tube again, thus giving a valvular opening lined with duodenal mucosa. In either case a tube is inserted down to the junction for a few days in case there should be any leakage of bile, but in satisfactory cases this should not take place. The bile should immediately pass along the tube into the duodenum.

POSTOPERATIVE CARE

The patient is returned to bed, and as soon as he begins to recover from the effects of the anæsthetic, ¼ grain of morphia and $^1/_{100}$ grain atropine are administered. His head is gradually raised, and when he is well round he is propped up until he is in a sitting posture. For the first 24 hours small sips of water just sufficient to moisten the mouth are given, and morphia should be administered as often as necessary. The room is kept warm with the window closed, for with so prolonged an operation there is always the danger of postoperative lung complications. After 24 hours, the amount of fluid given by the mouth is increased to 2 drams, and may consist either of water, diluted tea, or lemonade. The amounts of fluid are gradually increased until on the third day he is having 1 ounce drinks hourly. On the fourth or fifth day the amount is increased to 2 ounces, and a little jelly, junket, or custard is added. The quantities of fluid and food are steadily increased after this until the tenth day his diet includes fish, eggs, and a little chicken. The wound should be dressed on the second day, and if there is no leakage of bile the tube may be withdrawn for 2 to 3 inches and the excess cut off. On the fourth day it should be dressed again, and, if there is still no leakage the tube may be completely removed. Very often evidence of the satisfactory progress of the operation may be obtained in the first 24 hours, for if there be postanæsthetic vomiting the vomitus may contain bile, indicating that it is freely passing into the duodenum. On the third day an enema should be given, and thereafter a careful watch must be kept on the stools to determine whether the bile is passing freely into the intestines. A watch must also be kept for the passage of the tube. Having been sutured in place with one suture of catgut, it will usually pass into the intestine on about the eighth or tenth day, but in some cases it is retained for a considerably longer period, and the stools should be carefully watched until it is found so that it may be determined with certainty that it has been passed.

RESULTS OF OPERATION

Either variety of operation is of necessity associated with a high mortality. With a terminal reconstruction the patient has either been exhausted by previous operations and a long-

continued biliary fistula, or is suffering from back pressure with hepatic insufficiency, or if performed as a primary operation after resection of a portion of the duct the operation itself is generally a tedious procedure in a patient who is often enfeebled. The lateral reconstructions are also performed on feeble and exhausted patients who are suffering not only from carcinoma or chronic pancreatitis but who have been for long subjected to biliary back pressure. Immediate operative shock will therefore give a high mortality, but if this be overcome, the only special risk is that of leakage from the anastomosis. With careful suturing this should be reduced to a minimum and be but little greater than after a partial gastrectomy. Early leakage will cause a duodenal fistula which if small will close naturally in a few days, but if large, will be a progressive and dangerous complication. If occurring later it may give rise to a local abscess instead of a fistula.

My own series of 24 cases included 9 of terminal reconstruction, 12 of lateral reconstruction, 2 of immediate end-to-end suture, and 1 of overlooked division.

Terminal reconstruction. Of the 9 cases in this series 2 died as the result of operation, one being performed after the resection of a carcinoma of the duct, and the second after an operative injury of 5 months' standing. Of the remaining 7, 3 have remained well and free from all symptoms for periods of 10, 4½, and 3 years respectively, one has had slight occasional attacks of jaundice, 2—both of whom had had several previous attempts at reconstruction and showed very narrow ducts far up in the hilum of the liver—have been failures with a return of obstructive jaundice, and 1 died 3 years after operation with jaundice and pyrexia.

Lateral reconstruction. Of the 12 cases in this group, 6 died as a result of the operation, a very high immediate mortality, but 3 had far-advanced carcinoma of the lower duct and 3 showed the ducts full of a clear mucoid fluid, the so-called "white bile," the presence of which is an indication of severe hepatic insufficiency. Of the 6 who recovered from the operation, 3 had carcinoma of the ducts from which they died at a later period. Two of them showed the presence of white bile at the operation, but nevertheless recovered from the operation and lived 4 and 15 months respectively before dying with secondary growths. In 3 cases the operation was performed for obstruction due to chronic pancreatitis and the presence of some condition which prevented the performance of cholecystoduodenostomy or gastrostomy. These patients are alive and free from all symptoms for 3, 6, and 6 years respectively after operation.

Fig. 8. The lower end of the tube is inserted into opening in duodenum and the flap turned upward over tube. The flap is sutured above to the duct and at sides to anterior wall of the duodenum.

FROM THE DEPARTMENT OF SURGERY, YALE UNIVERSITY

GASTROJEJUNOSTOMY WITH A TRANSVERSE JEJUNAL INCISION FOLLOWING A PARTIAL GASTRIC RESECTION

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THE longitudinal jejunal incision impairs the efficiency of the resulting anastomosis in the usual methods for making a gastrojejunostomy. The orthodox jejunal incision (longitudinal) necessarily severs the circular muscle fibers throughout the length of the stoma. The contraction of the severed circular muscle fibers can have no effect on the propulsion of food along the intestinal canal but merely shortens the distance between the edges of the anastomotic opening. Consequently there is a tendency to the formation of an atonic, dilated pouch in the jejunum immediately opposite the stoma, in many instances, after the Pólya type of procedure. The proximal and distal jejunal loops naturally gravitate downward at either end of the stoma with the production of an acute angulation that may result in a partial obstruction. These short comings can be obviated by the utilization of a transverse jejunal incision.

Although the inherent mechanical deficiencies of the orthodox side-to-side gastrojejunostomy were clearly demonstrated by Cannon and Blake (1) about 20 years ago, surgeons have failed to make a clinical application of their observations. These investigators repeatedly observed the passage of food through the patent pylorus, into the duodenum and back to the stomach via the gastroenterostomy opening. This circulation of food usually occurred when the stomach was dilated by large amounts of food and water. The phenomenon is the result of valve formation at the anastomosis. When the wall of the stomach is stretched so that the edges of the opening into the jejunum are separated, the intestinal wall becomes flattened over the stoma and the openings into the stomach are converted into narrow slits. The opening on the proximal side of the stoma is patent for food which circulates via the pylorus and duodenum into the stomach, but both slits act as valves preventing the egress of food from the stomach (Fig. 1). The valves become more effective with greater gastric dilatation. Cannon and Blake also demonstrated this phenomenon by distending the excised stomach with water.

In previous communications (2 and 3) experiments were reported in which a comparison was made between gastro-enterostomies (in dogs) performed according to the orthodox technique with those in which a transverse jejunal incision was utilized. In the latter group there was no tendency to the formation of a valve. In fact dilatation of the stomach had the opposite effect of enlarging the stoma and maintaining its patency (Fig. 1). In contrast there were three poor results in ten anastomoses made with the usual longitudinal jejunal incision. In these animals the stoma was much enlarged and a definite valvular obstruction was evident. There were no adhesions or permanent kinks and the obstruction could be attributed to the valve formation only.

In further studies (4) a transverse jejunal incision was utilized in an end-to-end gastrojejunostomy after a partial gastrectomy. This method has the following advantages: The procedure is an end-to-end anastomosis and has the mechanical and physiological advantages that are generally conceded to this type of operation. In addition, the interference with peristalsis that follows a division of the circular muscle fibers is avoided and conditions favorable to the formation of an atonic pouch are not produced. After this end-to-end gastrojejunostomy the jejunal loops naturally gravitate downward, which is the optimum position for the maintenance of a patent stoma, while this same tendency after anastomoses of the Pólya type may tend to kink and partly occlude the lumen.

The purpose of the present communication is to present the clinical application of the transverse jejunal incision in restoring the gastrointestinal continuity following a partial gastrectomy. This incision has been used in operations of Billroth II and Pólya types.[1]

OPERATIVE TECHNIQUE

The operation (Pólya type) is performed in the following manner: After a partial gastric resection has been completed, the jejunum is brought through an opening in the transverse mesocolon and approximated to the stomach for a retro-

[1] The terms Billroth II type and Pólya type are used to designate anastomoses made between the jejunum and the posterior wall of the stomach and the transected end of the stomach respectively, after a partial gastric resection.

colic anastomosis. The proximal jejunal loop is made as short as is consistent with the extent of the resection. Two small crushing clamps are applied to the jejunum at the site selected for the anastomosis (Fig. 2). These clamps are placed side by side, extending transversely across three-fourths of the diameter of the intestine (about ¼ inch of jejunum is left at the mesenteric border). An incision is made between these clamps and their handles are separated. The length of the jejunal incision, after separation of the clamps, is usually from 2 to 2½ inches. In those instances in which the proximal jejunum is smaller than the average, a larger stoma may be obtained by the application of the clamps as in Figure 4 and the excision of a wedge of jejunum. By this device the length of the opening is increased by approximately one-third.

This portion of the jejunum is then united to the cut end of the stomach by a row of interrupted silk sutures forming the posterior suture line (Fig. 2). The crushing clamps are removed. The open ends of the stomach and jejunum are then united in the following manner: A continuous through-and-through catgut suture is inserted, beginning in the middle of the anastomosis posteriorly, and is continued in both directions. This suture is carried around either angle as a continuous inverting mattress stitch (Connell's suture). The stomach is not puckered but the excess is closed in the usual manner. The anterior portion of the suture line is re-enforced with a row of interrupted sutures of fine silk.

The jejunum and the stomach are then drawn through the opening in the transverse mesocolon. The cut edges of the mesocolon are sutured to the stomach with interrupted sutures of silk. The anastomosis is complete. The transverse jejunal incision may be utilized with antecolic or retrocolic anastomoses.

In the antecolic operation it is advisable to make an entero-enterostomy between the proximal and distal jejunal loops. In operations of the Billroth II type the cut end of the stomach is closed and a posterior side-to-side gastrojejunostomy is made with a transverse jejunal incision (Fig. 3).

This procedure has been utilized in four instances including Billroth II, retrocolic Pólya, and antecolic Balfour-Pólya types of procedures.

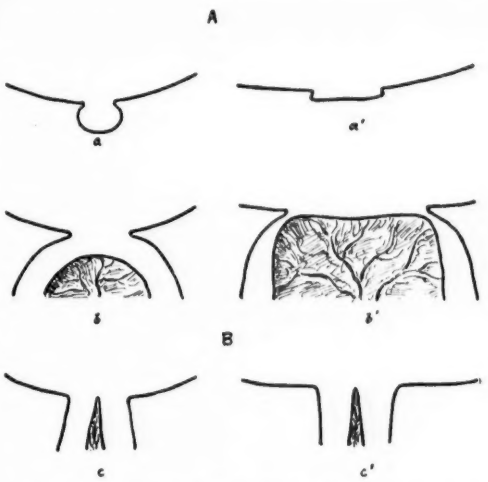

Fig. 1. A diagram showing the effect of extreme gastric dilatation on the stoma, A, in the usual side-to-side gastro-enterostomy (longitudinal jejunal incision); B, in the new type of procedure (transverse jejunal incision). The normal stoma is represented in the usual procedure in a and b, in cross section and longitudinal section respectively, and c represents a longitudinal section through the stoma after a gastro-enterostomy with a transverse jejunal incision. The dilated stomach is represented in a', b' and c'; the mechanism of valve formation is illustrated in a' and b', while in c' the dilatation produces an enlargement of the stoma.

CASE REPORTS

CASE 1. The patient, J. L., a white man, 67 years of age, was admitted to the New Haven Hospital on April 7, 1925, complaining of indigestion. About 18 months before admission the patient commenced to suffer from dull, epigastric pains. At the same time he began to lose weight and strength. The family history and personal history were irrelevant. On admission to the hospital the patient was poorly nourished and showed evidence of loss of weight. There was an indefinite mass in the right upper quadrant of the abdomen. A rectal examination was negative. An X-ray examination showed a filling defect at the pylorus with partial obstruction.

Clinical diagnosis. Carcinoma of the stomach. April 13, 1925, a laparotomy was performed, a freely movable carcinoma of the stomach was found with partial pyloric occlusion and metastases to the regional pyloric lymph nodes. The following procedure was then done: partial gastrectomy—end-to-end gastro-enterostomy with a transverse jejunal incision (antecolic Balfour-Pólya type); lateral anastomosis between proximal and distal jejunal loops. The immediate convalescence was entirely uneventful. There was no nausea or vomiting. The wound healed *per primam.*

May 7, 1925. An X-ray examination showed that the stomach was emptying satisfactorily. There was no retention of barium after 6 hours. The patient was discharged 24 days after operation.

Subsequent course. The patient remained in fair condition for about 9 months. There was slight abdominal pain but no nausea or vomiting. In January, 1926, he commenced to lose weight and suffered from more pain. There were no symptoms suggesting obstruction at the anastomosis. The patient died on February 17, 1926.

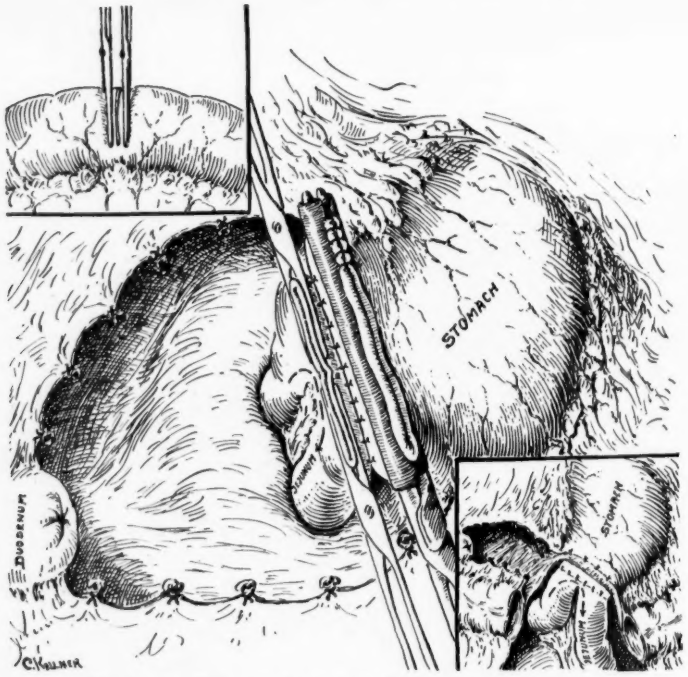

Fig. 2. The drawing illustrates the method of performing a retrocolic anastomosis (Pólya type) with a transverse jejunal incision. The resection is complete. The clamps have been separated. The jejunum has been approximated to the transected end of the stomach and the posterior row of interrupted sutures has been completed. The clamps are now removed and the anastomosis is completed in accordance with the usual methods. The upper insert shows the method of applying the clamps and making the transverse jejunal incision. The insert is partly diagrammatic as in practice the clamps are placed as close together as possible. In the lower insert, a portion of the transverse colon is omitted to show the completed anastomosis as it appears *in situ*.

The transverse jejunal incision was utilized in making an end-to-end gastro-enterostomy following a partial gastrectomy for carcinoma of the stomach. The stoma functioned satisfactorily for 10 months. The patient died of a recurrence of the neoplasm without evidence of encroachment on the lumen of the anastomosis. The freedom of the patient from any symptoms of obstruction is indicative of the mechanical efficiency of the anastomosis.

CASE 2. The patient, C. A., a white male, 52 years of age, was admitted to the New Haven Hospital on March 22, 1926, complaining of epigastric pain. The patient had an attack of dull epigastric pain in 1915. Two years later he had a second attack and since that time they have gradually increased in frequency. The duration of the pain varied from 12 to 48 hours. A sore spot persisted in the upper abdomen between attacks. The family history and personal history were irrelevant. On admission the patient's general condition was good. There was a tender spot just to the right of the umbilicus. The examination was otherwise negative. An X-ray examination showed a filling defect in the pyloric antrum. The stomach emptied slowly and there was a considerable retention of the barium after six hours.

Clinical diagnosis. Carcinoma or ulcer of the stomach.

March 24, 1926. Laparotomy was performed: the findings were a duodenal ulcer with partial pyloric occlusion and an ulcer on the posterior wall of the stomach near the lesser curvature in the pyloric region. Partial gastrectomy was done: a posterior gastro-enterostomy with transverse jejunal incision (Billroth II type). There was no nausea or vomiting. The wound healed *per primam*. An X-ray examination (April 8, 1926) showed a normally functioning stoma. There was no gastric residue after 6 hours. The patient was discharged 16 days after operation.

December 4, 1926. The patient has been relieved of his symptoms. An X-ray examination showed a normally functioning stoma. There was no gastric residue after 6 hours.

November 19, 1928. The patient is in excellent general condition and has no gastric symptoms.

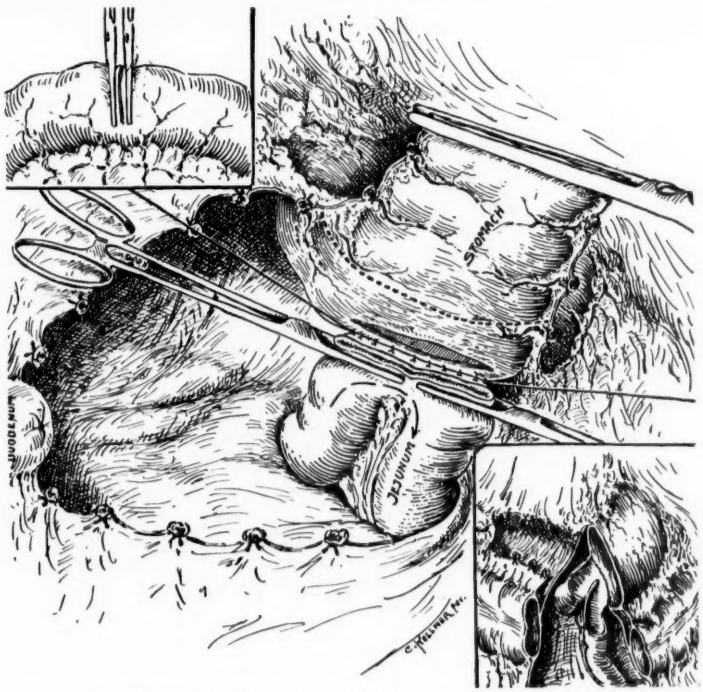

Fig. 3. The drawing illustrates the method of performing a retrocolic anastomosis (Billroth II type) with a transverse jejunal incision. The stomach has been lifted toward the left. The clamps have been separated and the jejunum has been approximated to the posterior wall of the stomach along the line of the proposed gastro-enterostomy stoma. The posterior row of interrupted sutures has been completed. The anastomosis is completed according to the usual methods. The end of the stomach is closed after a transection along the dotted line. The upper insert shows the method of applying the clamps and making the transverse jejunal incision. In the lower insert a portion of the transverse colon is omitted and the anterior portion of the stomach and jejunum at the anastomosis have been excised in order to show the appearance of the completed anastomosis from within.

The transverse jejunal incision was utilized in making a posterior gastro-enterostomy (Billroth II type) following a partial gastric resection for a co-existent gastric and duodenal ulcer. The anastomosis has functioned satisfactorily for about 3 years. The patient has had a complete symptomatic relief.

CASE 3. The patient, A. R., a white woman, 67 years of age, was admitted to the New Haven Hospital, October 18, 1926, complaining of stomach trouble. The patient states that she has suffered from abdominal discomfort for about 6 years. At first there was a localized dull pain coming on 15 to 20 minutes after eating. This was associated with gaseous eructations and occasional vomiting. During the last year the pain has become more severe and the vomiting more frequent. She has lost about 25 pounds during the last 3 weeks. At the time of admission the pain was continuous.

The family and personal histories were irrelevant.

On admission to the hospital the patient was found to be poorly nourished and suffering from abdominal pain. There was a freely movable mass just to the right of the umbilicus. Rectal examination was negative. An X-ray examination showed a very narrow streak of barium passing through the pylorus. There was no 6 hour residue.

Clinical diagnosis. Carcinoma of the stomach.

October 21, 1926. Laparotomy was performed. The findings were an annular carcinoma of the pyloric portion of the stomach with a partial pyloric stenosis and metastases to the regional pyloric lymph nodes. A partial gastrectomy was done: end-to-end gastro-enterostomy with a transverse jejunal incision (retrocolic Pólya type). The immediate convalescence was entirely uneventful. There was no nausea or vomiting.

November 10, 1926. An X-ray examination showed the stomach emptying satisfactorily. There was no gastric residue after 6 hours. The patient was discharged twenty days after operation.

May 23, 1927. General condition was good (7 months after operation). There was no evidence of a recurrence.

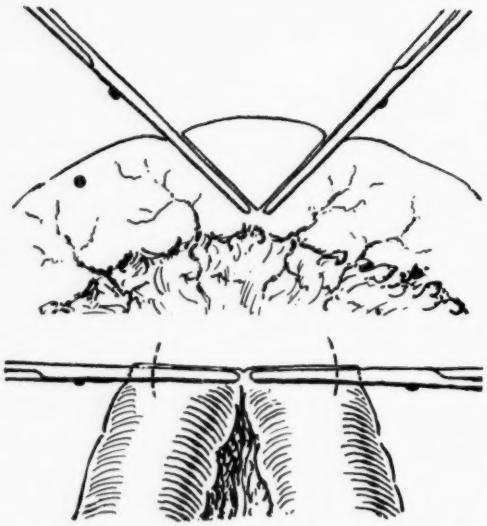

Fig. 4. The diagram (upper figure) shows how the clamps may be placed in instances in which the proximal jejunum is unusually small. In the lower figure the wedge of jejunum has been excised and the clamps separated. This device increases the length of the stoma by approximately one third. The broken lines mark the length of the opening obtained when the clamps are placed as in Figures 2 and 3.

September 17, 1928. General condition unchanged except that the patient felt weak. No definite evidence of a recurrence was found. An X-ray examination showed that the stoma was emptying satisfactorily. There was no residue after 6 hours.

December 8, 1928. For about 6 weeks the patient has complained of weakness, loss of appetite, and epigastric pain. There was no nausea or vomiting. She had lost about 10 pounds in weight. Examination showed definite jaundice. There was a large palpable mass in the right upper quadrant of the abdomen.

Final note. The patient steadily declined and died on February 13, 1929. During the last 6 weeks the pain became more severe and morphia was required for relief. During the 2 weeks before death there was some nausea and vomiting.

The autopsy findings were a recurrence of the carcinoma with complete occlusion of the common bile and pancreatic ducts. The greater part of the recurrent neoplasm was extra gastric, although there was extension of the growth into the stomach along the lesser curvature (Fig. 4), with partial occlusion of the anastomosis. This probably accounted for the terminal vomiting.

An end-to-end gastro-enterostomy with a transverse jejunal incision was performed following a partial gastric resection for carcinoma (retrocolic Pólya type). The anastomosis functioned satisfactorily. The patient remained in good health for about 2 years when evidences of a recurrence of the neoplasm were observed. The patient became jaundiced and died on February 13, 1929. The anastomosis functioned adequately, as is evidenced by the absence of nausea and vomiting until the terminal stages of the disease. At autopsy the neoplasm had encroached on and partially occluded the stoma.

CASE 4. The patient, L. S., a white woman, 67 years of age, was admitted to the New Haven Hospital on June 14, 1928, complaining of stomach trouble. About 6 years before admission the patient commenced to have mild distress in the epigastrium associated with flatulence and belching. Three months before admission she passed several loose black tarry stools. She lost about 15 pounds in weight during the last few months before admission to the hospital. She had not had any nausea or vomiting. The general physical examination was essentially negative. The dilated stomach was visible and palpable. A mass was felt extending transversely across the epigastrium toward the right side. An X-ray examination showed a filling defect completely obliterating the pyloric portion of the stomach. There was a marked 6 hour residue.

Clinical diagnosis. Carcinoma of the stomach.

Laparotomy was done June 19, 1928. The findings were a carcinoma of the lesser curvature and metastases to the regional lymph nodes. Partial gastrectomy and end-to-end gastro-enterostomy with a transverse jejunal incision (retrocolic Pólya type) were performed. The patient vomited a few times immediately after operation. Convalescence was otherwise uneventful. An X-ray examination before discharge showed that the anastomosis was functioning satisfactorily. There was no residue after 6 hours. The patient was discharged 29 days after operation.

November 12, 1928. The patient has been completely relieved of her symptoms. There has been no nausea or vomiting. An X-ray examination showed that the anastomosis was functioning perfectly. There was no residue after 6 hours.

The transverse jejunal incision was utilized in making a retrocolic end-to-end gastro-enterostomy following a resection of a carcinoma of the stomach. The patient was in good condition about 9 months after operation. There was no evidence of recurrence. The anastomosis is functioning satisfactorily.

DISCUSSION

The prerequisite of a successful gastro-intestinal anastomosis is a high degree of mechanical efficiency of the end-result. The deficiencies of the longitudinal incision and the efficiency of the transverse jejunal incision have been demonstrated by previous clinical and experimental studies.

Although the utilization of the transverse jejunal incision in performing a gastro-enterostomy is not entirely new, the older methods fall short of completely developing the possibilities of the transverse incision. According to the older methods (Kocher, Mikulicz) the maximal size of the opening is equal to the diameter of the intestine, but in the operation described in this paper

the length of the incision is approximately equal to twice the diameter of the intestine. It should be emphasized that the greater possible length of the longitudinal jejunal incision does not increase the efficiency of the anastomosis as the maximum possible size of the *effective lumen* in any type of anastomosis can be no larger than a cross section of the intestine at the level of the anastomosis.

The advantages of the transverse jejunal incision according to the new method are several: The circular muscle fibers are not severed and accordingly there is a minimal interference with peristalsis; the afferent and efferent intestinal loops gravitate downward, without kinking, into the optimum mechanical position; there is no tendency for distention of the stomach to produce a valvular obstruction but on the contrary it maintains the patency of the lumen.

The utilization of the transverse jejunal incision in a simple posterior gastro-enterostomy has been previously reported. In the present communication a report is made of the application of this procedure in anastomoses of the Billroth II and Pólya types.

The results of the clinical application of the transverse jejunal incision in anastomoses following a partial gastrectomy are presented. The method has been utilized successfully in many experimental animals, and in four patients following partial resection of the stomach. Two of the four patients died of recurrence of the gastric cancer 10 and 28 months after operation respectively. They benefited for periods of 9 and 24 months of relief from obstructive symptoms. The two other patients are alive and well at the present time: the one with a gastric ulcer about 3 years after operation and the other for 9 months after resection of a gastric cancer. The latter patient shows no evidence of a recurrence. The former has been completely relieved of all gastric symptoms.

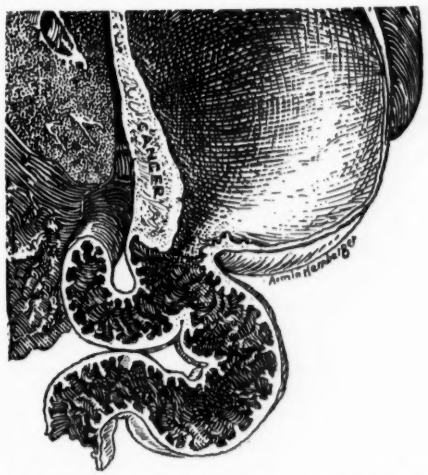

Fig. 5. The drawing shows the anastomosis as it appeared in the fixed specimen removed at autopsy in Case 3. The recurrence of the neoplasm along the lesser curvature partly occluded the stoma. The healing at the anastomosis was perfect.

Although the results are not brilliant in regard to the cure of gastric cancers, they are illustrative of the excellent mechanics of gastro-intestinal anastomoses in which the transverse jejunal incision is used.

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THE PREVENTION OF ABDUCTOR PARALYSIS IN THYROIDECTOMY

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UNILATERAL abductor paralysis is unfortunate; bilateral abductor paralysis is a tragedy. It is scant comfort to the surgeon —and certainly no comfort to the patient—to have the paralysis appear several days after the operation, or after the patient leaves the hospital. Frazier, Sir Charles Ballance, and others have made contributions to the subject of nerve anastomosis, but there is still much to be done in this field. Massage, electrical treatments, local applications, yield meager net results. Prevention is the ideal treatment.

The prevention of abductor paralysis has little to do with a knowledge of anatomical landmarks —every student of surgery knows where those nerves are! The surgeon experienced in thyroidectomy reviews the position of the recurrent nerve as an evil memory. It is not its anatomical location, however, but rather the vulnerability of its structure, the neighborhood changes of fixation and adhesions, and certain characteristics of the nerve conduction, which form the hazards.

Vulnerable structure of the recurrent nerve. The slightest direct, or even indirect, pressure on the recurrent nerve interferes with nerve conduction and immediately changes the voice. By contrast, the peripheral nerve fibers can undergo much trauma without resultant motor or sensory disturbance, but the naked recurrent nerve is almost as sensitive as is the naked brain or the spinal cord. Struggle and survival probably have not influenced such vital organs as the larynx and trachea which have always demanded complete protection, the alternative being death. Whatever the cause, these nerves are exceedingly sensitive, exceedingly delicate, and the action current through them is easily blocked. In their vulnerability the recurrent nerves must be classed with the brain, the spinal cord, the optic, the auditory, and the splanchnic nerves; the exceeding vulnerability of the recurrent nerve is, therefore, the first and most important factor in the production of abductor paralysis.

Neighborhood changes. A most important neighborhood change is the formation of adhesions between the capsule of the thyroid and neighboring structures, including the recurrent nerves. Such adhesions are frequently seen in cases of hyperthyroidism, of thyroiditis, of malignant growth, and following excessive radiation. The rôle which adhesions play in the production of abductor paralysis will be referred to later.

The fixed point of the nerve. The recurrent nerve enters the box of the larynx and is attached to the abductor muscles (Fig. 1), and for this reason it has something of the vulnerability of the nerve root of the spinal nerves. The exquisite sensibility of the laryngeal mucosa is of the order of the sensibility of the cornea; the sensibility of the laryngeal nerve is comparable to that of the optic nerve. Here we have an ideal setting for trouble—a slender, highly vulnerable nerve; its normal attachment rather indifferently secured by the ramifications of cervical fascia, and when a goiter is present, by adhesions—a loose-lying, vulnerable nerve, one part attached to a goiter which is movable, and the end fixed to the larynx.

The most common direct cause of abductor paralysis is the pull on the nerve which may occur when the goiter is rolled out. The most disastrous effect is produced when the nerve is disturbed by the dislodgement by the finger of an upper lobe which has thrust itself behind the larynx. Such a direct pressure and pull on the laryngeal nerve have probably caused more paralyses than either forceps or knife. Any pull on the nerve may cause partial and temporary, or complete and permanent paralysis. By this I do not mean to imply that the recurrent nerve is never injured directly by forceps or knife, by rough sponging, or by packing to control bleeding; however, abductor paralysis is probably most frequently caused by traction.

Late paralysis due to scar formation. It is certain that if the nerve trunk is directly exposed in the course of the operation, the exposed nerve will be covered by scar tissue. Scar tissue is capable of producing a block of the action current, hence of causing a physiologic severance of the nerve, and this is as great a tragedy as direct division of the nerve, for no plastic operation can be done and usually conduction is not re-established.

Prevention. In order to protect the recurrent nerve, therefore, resection must be made without the use of force in rolling out or in elevating the goiter. The following technique has given us excellent results:

a. The usual skin incision.

b. A V-shaped cut upward and downward between the platysma and the skin sufficient to

permit the following steps: (1) a vertical incision through the fascia, from the level of the upper larynx down to the sternum; (2) separation of the muscles, vertically, from the upper larynx to the sternum, exposing the capsule of the thyroid; (3) division, between forceps, of the thyroid, regardless of its thickness, down to the covering of the trachea and of the larynx; (4) division, between slender, dependable forceps, guided by sight and touch, of the attachment of the thyroid to the larynx and trachea, a thin covering being left as a protection for the trachea and larynx.

c. This progressive division between forceps of the goiter's laryngeal attachment is carried downward and slightly outward, until the entire lobe is sufficiently freed so that it can be raised up gently.

d. The goiter is freed from its more external attachment to the muscles, etc.

e. Although the goiter rises progressively out of the neck it still has deeper attachments, both to the larynx and to the adjoining muscles and fasciæ.

f. Each point of resistance is next grasped and divided between forceps, and the entire lobe can then be rolled out of the deep recesses of the neck.

Special points. a. If the goiter is retrolaryngeal, then, when its attachment to the larynx is completely severed, the retrolaryngeal portion slides out almost without aid and the voice is not even changed in pitch.

b. If the goiter is substernal, the process of delivery resembles the laying of an egg.

c. If the goiter is behind the trachea, it is easily drawn out. It matters little into what recesses the goiter has thrust itself, when its attachment to the larynx is divided it tends to extract itself because of the severing of the attachment and the release of the pressure.

d. Since the nerves lie in the tracheo-œsophageal space, the dissection is not only carried downward and outward but, until the deep capsule is reached, it is kept within the gland where there is no danger of approaching the nerve. When the deep capsule is reached, the forceps are so placed

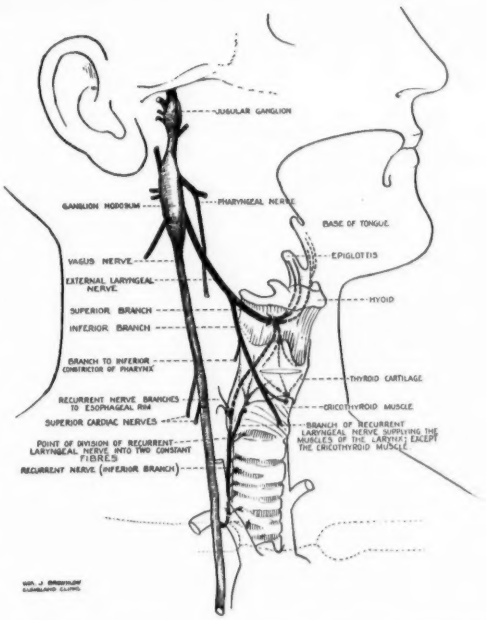

Fig. 1. Relation of the recurrent laryngeal nerve to the innervation of the pharynx, trachea, and œsophagus.

that a margin of thyroid tissue is left behind for the protection of the recurrent nerve during the operation and for another and equally important reason, namely, the protection of the nerve against scar formation.

Protection of the nerve against scar formation. The posterior margin of the thyroid, that part lying between the capsule and the nerve, is "no-man's land." It is not palpated; it is subjected to the least possible traction, and no division of tissue is made, so that no paralyzing scar can form during the healing of the wound.

By these precautions temporary and permanent injury of the recurrent nerve may be completely eliminated, except in the occasional case in which a technical emergency arises.

RUPTURE OF THE BLADDER

A Clinical Study of Fifty-Five Cases[1]

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OF major injuries to the urinary bladder, rupture is the most frequently observed and is of the gravest concern. Bladder wounds, whether caused by penetration from without (gunshot, sharp pointed instruments, etc.) or by perforation from within by cystoscope or lithotrite, present fewer diagnostic difficulties and the ultimate mortality is lower even though the same surgical procedures must be employed as when one treats bladder ruptures. The great difficulty encountered in correctly diagnosing vesical rupture and the high mortality resulting from the lesion, renders this comparatively rare condition of great clinical interest. In many instances the diagnosis is made only at operation or autopsy. Treatment demands early and rapid operation with the institution of ample bladder drainage. Of the 55 cases here reported from Bellevue Hospital, 35 died—a total mortality rate of 63.6 per cent, which, though high, is quite in harmony with the observations of others who have studied this subject.

Over 90 per cent of vesical ruptures occur in males. Explanation of this incidence is found in the more violent nature of male activities and work, the lower position of the female bladder within the more ample female pelvis, and the interposition of the uterus between the bladder and the vertebral column. In this series, but three cases of vesical rupture in females were observed. The first, an actress aged 22 years, died of vesical rupture and peritonitis induced by suicidal alcoholism. In the second case, a girl of three, rupture occurred during a severe beating, and the third female, aged 41, was crushed between two motor cars.

The incidence of ruptured bladder varies from 1 in 5,000 to 1 in 7,500 surgical cases. During the period of this study (January 1, 1914, to July 1, 1928) slightly over 300,000 surgical cases were admitted to Bellevue Hospital with a vesical rupture incidence of 1 in approximately 5,500 cases. The majority of these patients were adult males although the youngest was a girl of three. The ages of these patients is indicated in Table I. It is noteworthy that bladder rupture in the fetus has been observed.

Vesical distention and pelvic anatomy have a direct relationship to the pathogenesis of rupture. The empty bladder is a pelvic organ and as such is well protected from external violence except as it may be involved in pelvic crushing. The full or distended bladder is an abdominal viscus and is exposed to external violences in the same manner as are the other abdominal organs. The vulnerability of the bladder, therefore, is in direct ratio to its state of distention. It is seriously questioned by many whether the empty bladder is ever ruptured although all will grant the possibility of perforation by bony spicules, gunshot, etc.

Spontaneous bladder rupture has been reported by some. In three of our cases such an occurrence would seem likely although it must be remembered always that the distended and often diseased bladder may be ruptured by the slightest trauma. Many bladders in elderly patients show hyaline degeneration. Others are diseased by inflammation (tuberculosis, ulceration) chronic distention with or without diverticulation (prostatic obstruction, urethral stricture, spinal cord lesions), or neoplasm.

Although the trauma may be no more than a misstep with a slight fall or the exertion of getting out of bed (as in a case of ours), suprapubic kicks, blows, or crushing pelvic injuries are most commonly noted. Cases of bladder rupture during labor, straining at stool, or lifting heavy weights have been observed by others.

Of the predisposing causes of vesical rupture in addition to distention, alcoholism or other forms of mental irresponsibility are most important. A third (19) of our patients suffered vesical ruptures during a state of acute alcoholism; many of these entered the hospital in alcoholic coma or delirium. As a corollary, a certain number are first seen in the psychopathic wards.

With the more general use of motor vehicles, a third of the recently reported cases received their injuries in or by an automobile. Nine (16 per cent) of our patients were so injured; 8 of them were pedestrians. The remaining injuries may be classified as industrial and as such sustain an important medicolegal as well as scientific in-

[1] From the Urological, First, Second, Third, and Fourth Surgical Services of Bellevue Hospital.

terest. Twenty-three or a trifle less than half of this series were industrial accidents—chiefly falls or pelvic crushings.

Rupture followed a fall in eleven instances. Apparently the distance fallen is of comparative unimportance; one patient who died fell but four feet. Another, who lived, fell eight stories. Crushing injuries are perhaps more frequently observed. In one of five (12) of this series, bladder rupture resulted from this cause. Furthermore, it should be noted that of the 55 cases here reported, in 20 there was associated pelvic fracture. Other causes of rupture given by these patients were: exploding dynamo (1), kicked by a horse (2), severely beaten (1), and in one instance a postal clerk bumped himself suprapubically against the corner of a desk. This accident resulted in a fatal vesical rupture. In two instances there was associated prostatic obstruction with chronic vesical distention.

Most writers on the subject leave one with the impression that with pelvic fractures, injuries of the lower urinary tract are comparatively rare. We studied 166 cases of fracture of the pelvis admitted to Bellevue Hospital from January, 1919, to January, 1928, and found that 25 (15 per cent) or one in every seven suffered also from vesical rupture. In three others, rupture of the posterior urethra had occurred. Furthermore, in many cases of fracture without demonstrable vesical rupture, distressing urinary symptoms were present as follows: acute retention (32), marked dysuria (5), and gross hæmaturia (36). Of 110 cases of pelvic fracture manifesting no urinary symptoms, 24 suffered fracture of the iliac bones, lesions comparatively distant from the bladder. It is evident, therefore, that a thorough examination for signs of urinary tract injury is strongly indicated in every case of fractured pelvis.

SYMPTOMS

In most instances shock follows receipt of injury and we noted that on admission, a fourth of the 55 cases brought into Bellevue were in shock, comatose, or moribund. Two died within 10 minutes after reaching the ward. Marked cardiovascular depression is usually observed; pallor is extreme, and the pulse is feeble or imperceptible. Systolic blood pressure readings between 50 and 70 millimeters mercury are commonly recorded. The general appearance and physical findings in many of these individuals strongly indicates internal hæmorrhage. Urinary tract involvement is suggested by exquisite local bladder tenderness but perhaps more notably by dysuria, hæmaturia, or absolute inability to void.

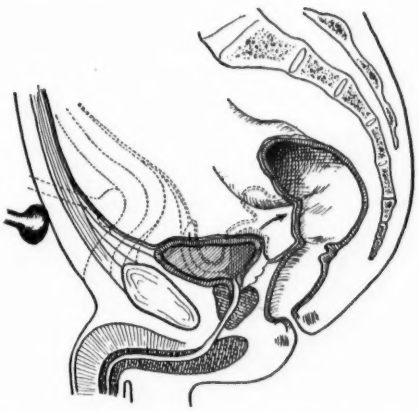

Fig. 1. Mechanism of rupture in slightly filled bladder. In these cases extraperitoneal rupture is said to occur more frequently. (After Rouvillois and Ferron.)

If intraperitoneal rupture has occurred, the early symptoms of peritonitis may be present. Abdominal tenderness and rigidity appear first; as the process progresses, nausea and vomiting may appear. Gastro-intestinal disturbances are rare except in the presence of peritonitis.

Oddly enough, this profound reaction does not ensue in all cases; certain patients are able to be up and about, blissfully ignorant of their truly perilous state. In one instance the patient was first seen in the psychopathic ward 9 days following rupture. He had been drinking heavily for 2 weeks previous to hospital admission but he remembered quite clearly that 9 days before examination his greatly distended bladder was suddenly relieved without voiding when he attempted to get out of bed. Laparotomy revealed an abdominal cavity flooded with urine and an associated peritonitis hastened death.

Even more striking in this connection, is the following history in which case the presence of vesical rupture was totally unsuspected and was disclosed only at autopsy.

H. C., male, aged 51 years, was admitted to one of the medical services of Bellevue Hospital complaining of slight swelling of the feet and general malaise. His condition had been getting progressively worse during the past week. There was neither history nor evidence of abdominal trauma, and the patient was voiding normal quantities of urine with but slightly greater frequency than normal. A diagnosis of cardiorenal disease was made and rest treatment instituted. On the third day after admission, evidence of considerable fluid in the abdominal cavity led to paracentesis at which time about 5 quarts of "urinous appearing and smelling fluid" was withdrawn. This comment apparently made no impression for on the sixth and

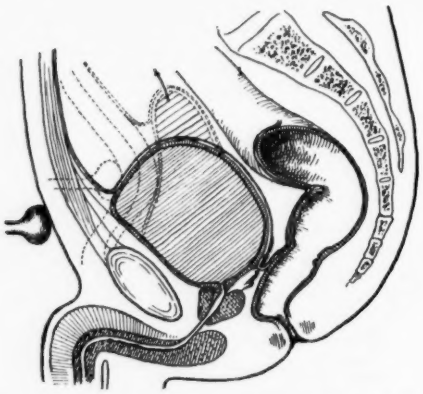

Fig. 2. Mechanism of rupture when bladder is full and trauma is of anteroposterior direction. Intraperitoneal rupture usually occurs. (After Rouvillois and Ferron.)

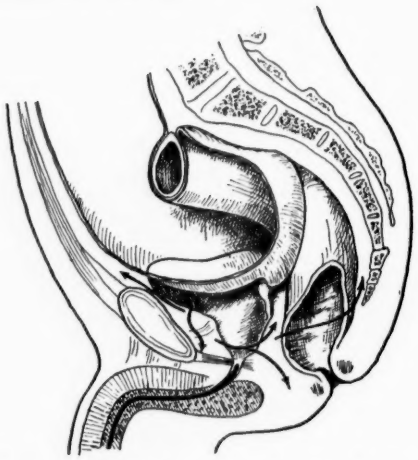

Fig. 3. Course of extravasation in cases of extraperitoneal vesical laceration. Perirectal and retroperitoneal infiltration may be extreme. (After Rouvillois and Ferron.)

ninth days the procedure was repeated. On the eleventh day the patient died and autopsy revealed a rupture of the dome of the bladder with no evidence of local trauma. A low grade generalized peritonitis was found. The vesical outlet was not obstructed.

While this case might be recorded as an instance of spontaneous rupture, its greater interest lies not only in the moderation of symptoms in a surgical disease of unusually high mortality but in its clinical deception. Nowhere in many pages of bedside follow-up notes, was a hint of the possibility of surgical urinary tract disease to be found.

DIAGNOSIS

A clear history is so often unobtainable and the clinical picture is so often that of extreme shock plus evident rupture of an abdominal viscus that the true diagnosis can be made only at operation. Rectal examination reveals little although it may indicate extravesical extravasation. Unless abdominal rigidity precludes a satisfactory examination, signs of free fluid in the abdomen indicate intraperitoneal rupture. In this series marked abdominal rigidity was found in 22 cases and unusual distention was seen in 31. Possibly this accounts for the fact that free fluid was demonstrated pre-operatively in but 7 cases. Extraperitoneal rupture was found in 21 patients whereas intraperitoneal rupture with free urine in the abdominal cavity was found in 34. The extreme condition of most of these cases when admitted to the hospital precludes protracted diagnostic efforts although there are certain tests and measures which may render positive diagnostic help.

The most commonly employed and probably the most inaccurate of these tests is that of catheterization. Often there is no urinous return or a small amount of blood may be withdrawn. At times a large amount of urine will flow—far more than the apparently undistended bladder would suggest. This signifies drainage of a urine filled abdominal cavity. The injection of a measured amount of fluid and the estimation of its return should always be tried although several factors mitigate against the accuracy of this observation. Experience has shown that even in the presence of vesical rupture the same quantity of fluid may return. In one of our patients, although the peritoneal cavity was flooded with urine, the small peritoneal tear over the bladder gave the appearance of fine lace work and permitted the urine to leak through but slowly. Moreover, plugging of the catheter by clots after injection has been made may prevent proper return flow. If the catheter has penetrated an abdominal pool of urine, as often occurs, a far greater quantity of fluid will be withdrawn. Diagnostically this constitutes the most significant of any of these catheterization observations. Although the catheter test possesses many inaccuracies, we believe it is always worth performing constantly bearing in mind, however, that by this means a previously sterile peritoneal cavity may become infected. This method was used in 41 cases of this series but was of real diagnostic value in only 13. From nearly all cases bloody urine was withdrawn

(which might indicate kidney trauma also); in most instances the withdrawal of a known injected quantity of fluid was unsuccessful because of catheter plugging with clots. In two instances, the catheter apparently drained a flooded peritoneal cavity.

When physical conditions will permit, cystoscopy is the most accurate method of diagnosis. However, vigorous and uncontrollable bleeding may render vision impossible or a large intraperitoneal rent may prohibit satisfactory bladder distention and thus prevent observation. We do not believe the added shock of cystoscopy is incompatible with sound surgical judgment but we do caution against prolonged cystoscopic sessions in these cases. A competent cystoscopist will know at once whether or not his instrument will be of use. In but six cases of this series was cystoscopy performed; in but four could the bladder wall be seen. More of these patients were not cystoscoped because, with few exceptions, they were admitted to the general surgical services and exploratory operations were performed at once. Aside from the possibility of added surgical shock, the same objection holds for cystoscopic procedures as for other bladder instrumentations—the probable introduction of infection.

Four years ago Vaughn and Rednick introduced vesical pneumoradiography—a diagnostic measure of striking ingenuity and accuracy even though the four cases in which they reported its successful use died. Following the injection of 50 to 100 cubic centimeters of air into the bladder, lateral abdominal roentgenograms are taken. If the bladder is ruptured intraperitoneally, the air is indicated within the abdominal cavity; it may localize just below the diaphragm. If the rupture is extraperitoneal, perivesical infiltration of air will be demonstrated. In some instances, the air dissects under the fascial planes. Without rupture, a vesical pneumogram of normal contour will be obtained. We have never used the method. Because of the symptomatic similarity of intraperitoneal vesical rupture and rupture of other abdominal viscera, immediate surgical intervention is usually indicated, at which time the correct diagnosis will be made. Extraperitoneal rupture is manifested by pericystic extravasation which often can be clinically identified. In one such case, extravasation involved the tissues of the lower groin and upper thighs. In a case of spontaneous rupture recently seen, marked perineal infiltration was observed.

Laboratory findings offer scant aid. Urinary changes other than hæmaturia are of no diagnostic value in these cases. The blood count shows comparatively little alteration except in the event of hæmorrhage or peritonitis. Hæmorrhage is indicated, of course, by a low or falling red cell count and hæmoglobin. White cell counts were done in 29 patients. Three showed a total count under 10,000; ten between 10,000 and 15,000; ten between 15,000 and 20,000, and six showed over 20,000. Polymorphonuclear differential count showed 5 under 80 per cent; 12 were 80 to 90 per cent; and 10 were over 90 per cent. Ninety-five per cent of the high white cell and polymorphonuclear counts accompanied peritonitis.

We do not advise protracted waiting in hope that the general condition of the patient will improve. Combat of shock is best achieved by blood transfusion although the administration of heat to the body, stimulants, and large quantities of fluids may serve partially to revive some of these patients. As a rule, however, the clinical course is one of depression; the condition of the patient becomes rapidly and progressively worse. For this reason, early operation is advisable, at which time transfusion, intravenous saline or glucose solution may be given and with proper bladder drainage will do most to reduce the ultimate mortality.

TREATMENT

The diagnosis of ruptured bladder seeming likely, operation should be performed at once. Nitrous oxide oxygen or ethylene anæsthesia is preferable in most instances although in a few cases of this series local infiltration was used. Spinal anæsthesia is contra-indicated in the presence of marked vascular depression with low blood pressure but was successfully employed in four cases. We do not, however, recommend spinal injection for surgical procedures in patients suffering profound shock.

In most cases intraperitoneal exploration is indicated. Several times at operation and at autopsy the abdominal cavity has been flooded with urine, yet it has proved extremely difficult to find the true bladder rent. Operative speed is imperative. If no evidence of intraperitoneal urine is found the peritoneum is closed and the bladder interior investigated. If peritoneal involvement is found, such fluid as is readily obtained is aspirated and ample drains are left. We caution against flushing out the abdominal cavity with saline or medicated solutions as this procedure not only wastes valuable time but disseminates infection.

The vesicoperitoneal tear is hastily closed by a minimum of sutures firmly grasping the bladder musculature. It is unnecessary to attempt layer

TABLE I.—AGE INCIDENCE IN YEARS

	Cases
Not stated	1
Under 10	3
10 to 19	3
20 to 29	7
30 to 39	16
40 to 49	12
50 to 59	11
60 to 69	2
Total	55

muscle suture of the bladder. Furthermore, it wastes time. Perivesical hæmatomata or extravasations should be amply drained.

Of greatest importance in the entire surgical procedure is the establishment of liberal suprapubic bladder drainage. We say this advisedly, having in mind some instances in which otherwise good general surgeons have attempted bladder drainage in these cases by means of rubber wick drains inserted through a small cystotomy opening. One must not hesitate to leave the bladder well open; on the urological service we usually employ a three-fourths inch tube for this purpose. With such free drainage, bleeding and extravasation will cease at once and smaller unsutured bladder wounds will promptly heal. Penetrating wounds caused by the bony spicules of pelvic fracture are rarely large enough to require suture. Such bony spicules, stones, or other foreign bodies present in the bladder should be removed while the bladder is open.

The location of the vesical rupture modifies in some instances the procedure employed. Involvement of the vesical outlet may include the posterior urethra and in these cases perineal as well as intrapelvic hæmatoma or extravasation are commonly observed. In addition to ample perineal incision and bladder drainage, we believe suprapubic drainage should also be instituted. Correction of the urethral obstruction can wisely be left for a more propitious time, since extensive and prolonged initial surgical procedures are strongly contra-indicated. One may profitably bear in mind that several cases are on record in which intraperitoneal rupture has been successfully treated by ample bladder drainage alone.

Drainage by external urethrotomy only is ill-advised treatment for bladder rupture. None of the four cases of this series treated by this method survived. In two other cases, perineal drainage supplemented cystotomy. Laparotomy was performed in 29 patients, cystotomy alone was done in 12, and in 10 cases no operation was possible.

The bacterial content of the urine determines in a large measure the ultimate outcome. The intraperitoneal injection of sterile urine will not cause peritonitis. Unfortunately, the urine of most of these patients is already infected or has become infected by instrumentation. The incidence of peritonitis, therefore, is high. In 23 of the 32 cases of intraperitoneal rupture, there was demonstrable peritonitis. Early intervention in the remaining cases probably accounts for the lack of gross evidence of this complication.

SURGICAL PATHOLOGY

If extraperitoneal extravasation has occurred, skin incision reveals a marked urinary œdematous infiltration of the perivesical tissues and the abdominal musculature. These structures are soggy, dead looking, grayish, or grayish red in appearance and may contain localized abscesses. Crepitus results from gas bacillus infection (usually other than bacillus welchii) and may often be elicited over a widespread area. In one case of ours the pelvis and lower groins were thus involved. In another instance autopsy revealed extravasation extending along the spermatic cord on each side to the scrotum.

Most ruptures are found on or near the dome of the bladder. Unusually long or multiple rents may offer both intraperitoneal and extraperitoneal urinary egress. While the transverse seems to be the commonest direction taken by these wounds, they may follow courses which are oblique or anteroposterior or may be bizarre modifications of T, Y, U, etc. A few ruptures occur at the bladder outlet and on the bladder floor and are most apt, as previously indicated, to give rise to perineal or subvesical hæmatomata and urinary extravasation. In one case coming to autopsy, retroperitoneal extravasation had ascended to the level of the kidneys. In this series, the location of the rupture was recorded as follows: dome (anterior or posterior), 37; lateral wall, 4; floor, 3; vesical outlet, 4; posterior wall, 1.

In one of our patients rupture of a diverticulum occurred and in such previously diseased bladders the co-existing pathological conditions—ulceration, tuberculosis, neoplasia, or degeneration—will be disclosed at operation. In but two of our cases was chronic vesical distention proved to be due to prostatic enlargement.

COMPLICATIONS

It is the complications induced by vesical rupture which kill. These complications are immediate or late. Shock or hæmorrhage may be extreme and quite promptly fatal. If the patient survives this initial period, extravasation and sepsis usually develop. If these are to prove fa-

TABLE II.—TREATMENT, MORTALITY

	Extra-peritoneal	Intra-peritoneal	Total
Total cases	21	34	55
Not operated upon	1	9	10
Total died	9	26	35
Operative	20	25	45
Operative, died	8	17	25
Operative mortality percentage	40	68	55.5
Total mortality percentage	42.9	73.5	63.6

tal, death ensues in most cases within one week. As indicated, peritonitis may be anticipated in approximately half of all cases. Associated rupture of abdominal viscera occasionally occurs and may likewise prove fatal. In this series splenic rupture was observed once and the intestines were ruptured in three cases. That death does not always follow such wounds is demonstrated by the fact that two of these patients lived following intestinal suture, there being two intestinal wounds in one case. At autopsy we have seen both liver and kidney rupture associated with vesical rupture and in this connection it is well to point out that a history of vesical injury plus the observation of a brisk hæmaturia does not rule out renal injury nor the possible renal origin of the blood. Observation of bloody ureteral ejaculation will give the cue.

Although fracture of the bony pelvis is often a serious immediate complication, subsequent acute osteomyelitis may prove fatal as in two patients of this series. One of these had received nine transfusions in an unsuccessful attempt to combat the sepsis of osteomyelitis, finally dying 8 months after the receipt of injury. In a patient observed recently, osteomyelitis of perivesical bony spicules gave rise to an abscess 6 months after pelvic fracture and vesical rupture. Incision and drainage with bony spicule removal was successfully performed. Following the initial operation, vesical fistulæ may be persistent and require resection as in two of our cases. One patient was in a plaster cast with suprapubic drainage for 6 months before the repair of a stenosed ruptured prostatic urethra and bladder neck could be undertaken. Late urethral resection for traumatic stricture was performed once.

Acute evisceration occurred in two patients shortly after operation. In the first, the wound was torn open on the second day by the patient's own hands; in the second case an attempt to get out of bed on the sixth day after operation brought on the condition. In both cases intestinal evisceration occurred and, as is the rule in such accidents, immediate abdominal closure proved hopeless.

TABLE III.—FATAL OPERATIVE CASES, INTERVAL BETWEEN INJURY AND OPERATION

	Intra-peritoneal	Extra-peritoneal
Less than 3 hours	1	4
Less than 6 hours	7	2
Less than 12 hours	4	..
12 to 48 hours	1	..
3 to 5 days	1	..
6 to 10 days	1	1
Unknown (not stated)	2	1
	17	

Other complications delaying convalescence or causing death were fractures of the leg (4), arms (2), amputation of arm for gangrene following fracture (1). An abscess of the groin and of the buttocks each required incision and drainage. Gas gangrene of the pelvis and lower groins occurred once.

PROGNOSIS AND MORTALITY

Of the 20 patients who survived (all of whom were operated upon), 5 were able to leave the hospital in less than 3 weeks; 6 left in 3 to 6 weeks; 5 in 6 to 12 weeks; and 4 remained in the hospital over 3 months. The longest stay was 6 months.

Of the 35 patients who died (10 of whom were not operated upon), 2 lived less than 10 minutes after hospital admission. Ten died within the first 24 hours, 14 more within 3 days, and all but 4 died in less than 1 week. One lived 8 months and died of osteomyelitis sepsis. From these observations we may deduce that if the patient survives the first week, a fair prognosis is rendered likely.

In all cases a grave prognosis is warranted during the first week, since the mortality is unusually high. A summary of case reports by others indicates that 60 to 80 per cent of these patients die even under the most favorable of surgical conditions. In this series 35 died, a mortality of 63.6 per cent or two-thirds. It is interesting to note that of those patients suffering intraperitoneal involvement 73.5 per cent (26) died and, what one might expect, but 42.9 per cent (9) of those with extraperitoneal involvement died. The operative mortality of the extraperitoneal group was 40 per cent; of the intraperitoneal group, 68 per cent.

The surgical outcome depends on many factors, however, the outstanding of which are: the age of the patient, the degree of shock, the extent and character of the injury, the bacterial content of the urine, and the rapidity with which surgical treatment is instituted and carried out. The liberal employment of transfusion is, together with

the establishment of free drainage to the bladder and sites of extravasation, our greatest hope in the lowering of the mortality following vesical rupture.

CONCLUSIONS

Bladder rupture is of comparatively rare incidence, is due to trauma, and is favored by vesical distention, alcoholism, and pre-existing disease of the vesical walls. The diagnosis is not easy to make in most instances and early and speedy surgical operative treatment is imperative. Without the establishment of free bladder drainage any operative procedure will be of no benefit to the patient. Two-thirds of these patients die. If intraperitoneal rupture has not occurred, the prognosis is twice as good as when such rupture does occur. If the patient survives the first week, his chances of recovery are greatly enhanced.

CORPOREAL AND CERVICAL CÆSAREAN SECTION

A Comparative Analysis of Results on a Teaching Service

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IN view of the present great interest in the cervical cæsarean section as a means of reducing maternal mortality in section done after the onset of labor, a review of our experience at the University of Pennsylvania was recently undertaken. The results of this survey may be of general interest for several reasons. In the first place, while the service commands only a small number of deliveries, it is one in which a wide variety of obstetric risks and complications are represented, entailing a high incidence of obstetric surgery of an emergency character. Second, the cervical cæsarean section has been employed in certain cases by six different staff members for the past 6 years, thus indicating a reasonable familiarity with its technique. Third, the clinic has maintained, first under the ægis of Professor Barton Cooke Hirst and more lately under one of us, a neutral attitude with respect to the cervical operation, neither advocating nor imposing any given course upon the several surgeons until sufficient experience should warrant an audit of results, if possible upon the basis of a comparable number of cervical and corporeal operations performed coincidentally for similar indications. Fourth, the clinic has had a unique experience with a variation of the classic or conservative operation, devised by the senior author, and voluntarily employed by all surgeons on the service in every case where a fundal approach has been chosen. Finally, the service still retains general anæsthesia for major operations (principally from considerations having to do with the teaching of large groups of students)—a practice which is perhaps still the general one in this regard, therefore making our figures of value to a large audience.

Aside from our interest in the general questions of mortality and morbidity, the chief object of the survey was to determine whether the cervical cæsarean section should displace the conservative operation, either after the onset of labor alone or as a routine method of abdominal delivery.

MATERIAL

In beginning the study it was noted that a review of the last 30 months would provide not only equal periods of 15 months under two departmental heads, but also 73 consecutive cæsarean sections comprising comparable numbers of the classic or corporeal and the cervical operation done under approximately similar indications. At the same time, the selection of the most recent cases would exclude the earlier years when our initial results with the cervical operation might be open to criticism owing to inexperience with its technique.

Tables I to IV illustrate the type of material and problems encountered by the clinic, as also something of its methods. About 80 per cent of patients are charity cases and nearly 30 per cent are colored. Between 10 and 20 per cent of delivered cases are admitted to the hospital as labor emergencies without prenatal supervision by the service. It would be only fair to add, however, that among over 200 such dystocias in the 300 months covered by this survey, there were no instances of ill-advised attempts at operative delivery prior to admission—a gratifying reflection upon the disappearance of a kind of emergency which was comparatively frequent in the clinic's earlier years. By the same token the records disclose no instance of embryotomy having been done during an even longer period, though this fact is also partly accounted for by our readier resort to section in the interest of the child in the face of risks formerly deemed prohibitive.

CONSIDERATION OF TECHNIQUE

Corporeal cæsarean section. The conservative sections in this series were mostly done according to a technique evolved several years ago by the senior author and adopted individually since that time by all members of the service. The principal features of this technique are illustrated in Figures 2 to 6. Aside from locating the uterine incision low on the anterior wall as suggested by the late Professor Studdiford, the method consists principally of meticulous care in coaptation and suture, as first emphasized by Saenger. To this is added the adoption of the surgical principle of carefully burying all sutures; we aim by this peritonealization to secure a wound which shall be sealed and leak-proof within a few hours after operation and shall remain so in spite of the after contractions of the uterus.

TABLE I.—INCIDENCE OF CÆSAREAN SECTION

Period of thirty months, from April 1, 1926 to September 30, 1928

According to	Deliveries			Cæsarean sections	Incidence
	White	Black	Total		
1. Total service deliveries	1997	1991	3988	73	1 in 54.6
South Eastern Dispensary (home deliveries)*	1128	1662	2790	..	..
Hospital deliveries	869	329	1198	..	1 in 16.4
2. Sources of 1198 hospital deliveries:					
Hospital Prenatal Clinic		710		31	1 in 22.9
Staff (Private cases)		248		21	1 in 11.9
Outside physicians†		101		12	1 in 8.3
South Eastern Dispensary†		109		9	1 in 12.2
Accident Ward		30		0	.....
3. Certain complications among 1198 hospital deliveries:					
Contracted pelvis		96		38	1 in 2.5‡
Placenta prævia and abruptio		49		4	1 in 12.2
Cardiac disease		13		1	1 in 13.0
Previous cæsarean section		31		24	1 in 1.3
4. Parity of 1198 hospital deliveries:					
Primigravidæ		389		25	1 in 15.6
Multigravidæ		809		48	1 in 16.9

*Home delivery service, situated in another section of the city and having its own prenatal clinic. Service under supervision of the professor of obstetrics, and deliveries conducted by senior students of the University Medical School. All major complications are referred to the University Hospital.

†Refers only to cases admitted in labor as emergencies or without prenatal supervision by the department.

‡High incidence of section in contracted pelvis explained by the fact that only the major contractions and failed test labors arising on the South Eastern service come to hospital.

TABLE II.—TYPES OF CÆSAREAN SECTION PERFORMED

	Emergency	Elective	Total
Fundal sections	20	24	44
High (classic)	9	10	
Low	11	14	
Cervical sections	14	11	25
Beck	8	3	
Kerr	6	8	
Other types	2	2	4
Marsupialization	2	..	
Porro	..	2	
Total	36	37	73

Coincidental operative procedures in 14 cases:	
Sterilization (tubal)	8
Appendectomy	2
Myomectomy	1
Ovarian cystectomy	1
Herniorrhaphy	1
Appendectomy, herniorrhaphy, sterilization	1
Average operative time in minutes in remaining sections (6 surgeons):	
Fundal	53
Cervical	68
Other types	83

TABLE III.—REPEATED CÆSAREAN SECTION

No previous cæsarean sections	49
One previous cæsarean section	17
Two previous cæsarean sections	5
Three previous cæsarean sections	2

The low position of the uterine wound makes the extraction of the fetus a trifle more difficult than when the incision is made in the fundus proper; care to secure both feet of the child, however, and to extract by a deliberate internal version, insures against tearing or extending the wound. The advantages of this site are that it keeps contamination of the peritoneum confined principally to the pelvis, and, since the peritoneal coat of the fundus is loosely invested at this level, renders the application of a Lembert sero-serous stitch practicable. The operator must be prepared to take pains in the introduction of the latter stitch and to employ small "bites" of the needle. While the method is time-consuming and perhaps tedious, we have found that the extra minutes and effort are well worth while even in operations of an emergency character. The smoother convalescence, freedom from tympanites, and greater safety secured by its use are in distinct contrast to our previous experience and more than counterbalance the slightly higher immediate febrile reaction incident to long operative time and the burial of a large amount of catgut.

Cervical cæsarean section. The cervical operations in this series were about equally divided between Kroenig or longitudinal, and the Kerr transverse or elliptical incision. The technical features of these operations are well known and are not particularly formidable for a practiced abdominal surgeon. The following comments need to be mentioned, however, in view of the current tendency of enthusiasts to minimize the risks. The cervical section is usually said to be most readily done after the onset of labor, when the lower uterine segment has become extended and thinned out. This is true for as long as the membranes remain intact and provided the head has not been allowed to mold excessively in protracted efforts to secure engagement. Under the latter circumstances, which would probably not obtain in test labor conducted in a well organized clinic, but which nevertheless are frequently the conditions under which emergencies reach the occasional operator, the extraction of the fetal head, deeply placed behind an overstretched bladder and tightly pressed against the pelvic brim by a molded uterus, is a matter calling for the ultimate in obstetric and surgical skill. The penalties are tears of the uterus and injuries to the bladder. The above is particularly true of the Kerr operation unless the transverse uterine incision is kept low enough to lie over the prominence of the fetal head. Disregarding this, the inexperienced surgeon will be chagrined to find a shoulder or arm prolapsing through the wound, and an extension

TABLE IV.—INDICATIONS FOR CÆSAREAN SECTION

	Emergency			Elective			Total
	Corporeal	Cervical	Other	Corporeal	Cervical	Other	
Contracted pelvis group							
Dystocia*:							
Dystocia only	6	8	1				14
Plus previous cæsarean		1	1				2
Plus eclampsia		1					1
Pregnancy, contracted pelvis, disproportion				4			4
Pregnancy, contracted pelvis, disproportion, previous cæsarean section				10	6		16
Contracted pelvis and placenta prævia	1						1
Total contracted pelvis			18			20	38
"Other Indications" group							
Dystocia:							
Due to disproportion	5	1					6
Same, plus previous cæsarean	1						1
Cervical dystocia, elderly primigravida	1	2					3
Cervical dystocia from previous operation			1				1
Sacculation due to previous operation	1						1
Sacculation from previous cæsarean	1						1
Intrapartum hæmorrhage (abruptio)	1						1
Primary inertia, pulmonary tuberculosis		1					1
Previous dystocia:							
Previous dystocia only					2		2
Same, resulting in stillbirths				2			2
Same, with previous cæsareans				3	1		4
Accidents of pregnancy:							
Placenta prævia	1						1
Abruptio placentæ	1						1
Incidental complications of pregnancy:							
Pulmonary tuberculosis				1			1
Cardiac disease					1		1
Ovarian cyst				1			1
Myoma uteri						2	2
Intestinal obstruction	1						1
Miscellaneous:							
Sacculation, previous ventrofixation				1			1
Sacculation, previous interposition					1		1
Habitual death of fetus				1			1
Disproportion only				1			1
Total, "Other Indications"			18			17	35
Total			36			37	73

*Of 32 operations for dystocia, 13 were strictly emergency, and 19 were so classified after a test labor conducted or completed in hospital.

TABLE V.—MATERNAL AND INFANT MORTALITY

	Emergency			Elective			Total
	Corporeal	Cervical	Other	Corporeal	Cervical	Other	
Total operations	20	14	2	24	11	2	73
Maternal mortality	1	1			1		3
Shock		1					
Postoperative hæmorrhage	1						
Peritonitis					1		
Infant Mortality	4	5	1	1	1		12
Stillbirths:							
Cerebral hæmorrhage		1	1				
Placenta prævia	1						
Abruptio placentæ	2						
Neonatal deaths*:							
Cerebral hæmorrhage		3					
Prematurity	1			1	1		
Congenital adenoma thyroid		1					

*Deaths occurring up to 2 weeks postpartum.

of the wound made necessary before the child can be delivered.

On the other hand, when the cervical section is performed before the onset of labor, the lower uterine segment is frequently thick and the source of troublesome hæmorrhage in some cases. The incision being in a non-contractile portion of the uterus, moreover, a tendency to atonic hæmorrhage will be present when general anæsthesia is used, a complication which the mere introduction of sutures will not counteract as it appears to do when the incision is in the more irritable musculature of the corpus.

While our experience with the cervical section in placenta prævia is too limited to justify a comment, initial trials and a consideration of certain obvious facts lead us to believe that the propriety of the procedure is by no means the ideal one claimed in some quarters, particularly if the surgeon be unprepared for the possible consequences.

It is perhaps obvious but appropriate to add that certain cases in which suspending adhesions from a former operation have kept the anterior uterine wall thickened (while sacculation of the posterior wall occurs) are also technically unsuited for the cervical section.

MORTALITY

There were three maternal deaths in the series, one from peritonitis (Table V). All occurred before the fourth day and are charged in review to "errors of judgment" in spite of two of the patients having been admitted as emergencies in precarious condition, since the series includes a number of comparable emergencies more happily managed. The mortality figures furnish no basis of comparison between the types of cæsarean section, since in every fatal instance the operation was ill chosen for the problem in hand.

MATERNAL MORTALITY

CASE 4362. Patient, aged 27 years, v-para, with justominor pelvis. Previous deliveries had been terminated by forceps. Ventrosuspension had been done after last childbirth. She was referred to the hospital *in extremis* after 36 hours' active labor at term, and an impacted mentoposterior position. She had been seen on the home delivery service and was twice urged to come to hospital, refusing which she had signed a "release." Finally, her people appealing to the hospital, she was admitted in a state of shock, but with the fetus still alive. An emergency cervical section was performed, which was technically complicated by adhesions formed after the previous operation. She failed to rally from shock, and died 4 hours after operation. Error in judgment.

CASE 5071. Patient, aged 40 years, vii-para. Previous deliveries had been spontaneous. Following last childbirth she had a modified interposition operation, which

TABLE VI.—MORBIDITY

	Emergency			Elective		
	Corporea	Cervical	Other	Corporea	Cervical	Other
Total operations	20	14	2	24	11	2
Febrile*, first 3 days	17	11	0	15	10	1
Febrile*, after third day	16	10	0	6	8	1
†Endometritis and sapræmia	10	5		4	3	
†Parametritis					1	
Peritonitis					1	
Pyelocystitis	4	1		1	3	
Mastitis (non-suppurative)	1	1		1		
Pneumonia		1				
†Bronchopneumonia	1					
Pulmonary tuberculosis		1				
Pleurisy						1
Hypodermic abscess		1				
Postoperative tympanites:						
Noted as present or absent	14	9	1	18	6	0
Absent	5	2		5	1	
Mild	3	2		6	3	
Moderate	4	3	1	6	1	
Marked	2	2		1	1	
Wound Complications§:						
Type "A"	2			1		
Type "B"	1	2				
Type "C"					1	
Average post-operative days	20.7	18.0	16.5	17.0	16.2	19.5

*A temperature of 100 degrees F twice in 24 hours, exclusive of the first 24, the temperature being recorded every fourth hour.

†In none of these was the lesion serious, nor the blood cultures positive.

‡Present before operation.

§Classification of the Woman's Hospital in New York. All actual wound infections, major or minor, fall under Type "C."

TABLE VII.—MORBIDITY OF CASES OPERATED ON FOR DYSTOCIA ONLY

	Corporeal	Cervical
Total operations	16	14
After test labor conducted or completed in hospital	11	8
Emergency operation on admission	5	6
Pre-operative data		
Average hours of labor pre-operative	29.2	32.0
Number cases of ruptured membranes	4	10
Average hours membranes ruptured	24.1	21.8
Average temperature pre-operative	99.1	99.2
Attempts at vaginal delivery	1	4
(All conducted in hospital including 4 attempted forceps, and one bag insertion)		
Average number of vaginal examinations		
None	3	1
One	4	3
Two to four	5	7
More than four	4	3
Febrile, first 3 days	14	11
Febrile after third day	14	10
Endometritis and sapræmia	10	5
Pyelocystitis	3	1
Mastitis	..	1
Pulmonary, acute	1	1
Pulmonary tuberculosis	..	1
Hypodermic abscess	..	1
Postoperative tympanites—notation	13	9
Absent	5	2
Mild	3	2
Moderate	3	3
Marked	2	2
Wound complications		
Type "A"	1	0
Type "B"	1	1
Type "C"	0	0
Average post-operative days	21	19

resulted, during this pregnancy, in posterior sacculation of the fundus, and symptoms serious enough to confine her to bed for 2 months prior to admission in the thirty-third week of pregnancy. Her condition was further complicated by an imperfectly controlled diabetes mellitus. Elective cervical section for relief of symptoms found the uterus anchored behind the bladder, with full thickness of musculature intact. There was profuse hæmorrhage. Patient died of general peritonitis on the fourth day. Error in judgment.

Case 5132. Patient, aged 28 years, ii-para, suffered from late toxæmia. Abruption of the placenta occurred in the thirty-eighth week of pregnancy. Patient was admitted to the hospital in shock fully 31 hours later. Emergency (fundal) section was chosen because of the absence of cervical dilatation and the presumptive loss of integrity of the musculature of the uterus. The uterus was found undoubtedly gangrenous, but owing to the patient's lack of fever (shock ?), and the clinic's previous favorable experience with conservative operation in these cases, a contemplated Porro operation was not carried out. With transfusion, the patient reacted promptly after operation. She collapsed suddenly within a few hours of operation and died shortly thereafter. Postmortem examination revealed postoperative intraperitoneal hæmorrhage, apparently from seepage through the uterine wound and the fallopian tubes. Error in judgment.

To attempt to divide the fetal mortality by type of operation would likewise lead nowhere, as would any attempt to establish the percentage of fetal mortality for cæsarean section in general in so small a series. The figures are elaborated in the appended case abstracts for the perusal of students of mortality. When these are closely examined, the data will be informative principally of the risks to the child in cæsarean section when the same is performed as an alternative to embryotomy in doubtful cases. This is apparent in the mortalities listed under placental accidents, and especially in the neo-natal deaths from cerebral hæmorrhage.

STILLBIRTHS

Case 4117. Patient, aged 36 years, vi-para, with justominor pelvis, had been delivered four times by means of forceps and twice by cæsarean section. Emergency admission to hospital took place after 50 hours in labor at term, 48 hours after rupture of the membranes. The fetus was dead when patient entered the hospital, but the condition of the cervix made craniotomy impossible. Marsupialization section was done. Diagnosis: cerebral hæmorrhage. Weight 2331 grams.

Case 4689. Patient, aged 21 years, i-para, with justominor pelvis. Previous delivery had been done by means of forceps; stillbirth. Emergency admission for placenta prævia took place in thirty-eighth week of pregnancy. The cervix was closed. The fetus was doubtfully viable. Emergency classic section was done in the interest of the child. Diagnosis: asphyxia, placenta prævia; Weight 3050 grams.

Case 4951. Patient, aged 28 years, nullipara, with justominor pelvis. Emergency admission to hospital took place after 96 hours of dry labor at term, and supervening

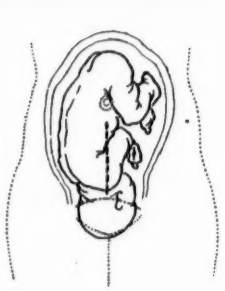

Fig. 1.

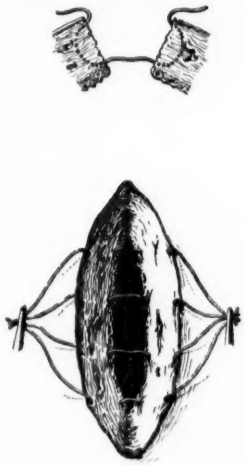

Fig. 2.

Fig. 3.

Fig. 1. Location of incisions. The abdominal incision is made entirely below the umbilicus. The uterus is opened by a midline incision beginning just above the bladder reflexion, thus exposing the fetal shoulder. In order to extract the fetus without extending or tearing the uterine wound, it is necessary to grasp both feet and deliver by a careful internal version.

Fig. 2. Uterine closure. Tension sutures of No. 2 20 day chromic gut take in the entire myometrium, avoiding the decidua. The free ends are brought out beneath the perimetrium.

Fig. 3. First tier. Continuous stitch, No. 1 20 day chromic gut, takes in the deeper half of muscle, avoiding decidua. Tension sutures not illustrated here.

intrapartum eclampsia. The fetus was doubtfully viable. An emergency Beck section was done for disproportion after failure of test forceps. Diagnosis: cerebral hæmorrhage. Weight 3900 grams.

CASE 5132 (see "Maternal Mortality"). Emergency section was done in the interest of the mother. The fetus was macerated. Diagnosis: asphyxia, abruptio. Weight 2054 grams.

CASE 6196. Patient, aged 27 years, i-para, with normal pelvis, suffered from toxæmia and abruptio placentæ in the thirty-eighth week, and failed to deliver after metreurysis and 22 hours of test labor. Membranes ruptured after 8 hours. Emergency low fundal section was done in the interest of the mother (continued uncontrolled hæmorrhage and fear of uterine gangrene). Diagnosis: intrapartum asphyxia, abruptio. Weight 2700 grams.

NEONATAL DEATHS

CASE 4015. Patient, aged 32 years, iii-para. Elective high fundal section was done in the interest of the mother, in the thirty-first week. Pressure symptoms were present due to the presence of a rapidly growing ovarian cyst, the size of a six months' pregnancy. Death occurred on the second day. Diagnosis: prematurity.

CASE 4362 (see "Maternal Mortality"). An emergency Beck operation was done in the interest of the child. Death occurred on the second day. Diagnosis: cerebral hæmorrhage.

CASE 4508. Patient, aged 16, nullipara, with justominor pelvis. A Beck section was done at term, after 20 hours of test labor obstructed by disproportion. Death took place on same day. Diagnosis: cerebral hæmorrhage.

CASE 4530. Patient, aged 21 years, i-para, with flat pelvis. Previous forceps delivery and stillbirth. After test labor of 95 hours, at the thirty-eighth week, characterized by irregular pains and premature rupture of membranes, the head remained floating. A Beck section was done. Death occurred in 2 hours from suffocation due to tracheal pressure from the large fetal adenoma of the thyroid. Postmortem pathological diagnosis: fetal adenoma. Weight 3255 grams.

CASE 5071 (see "Maternal Mortality"). Elective Kerr section was done in interest of mother. Death occurred on the same day. Diagnosis: prematurity.

CASE 5189. Patient, aged 38 years, nullipara, with normal pelvis, suffered from late toxæmia. Patient failed to deliver after 24 hours test labor at term; membranes ruptured in 5 hours. A Kerr section was done in the interest of the child and for cervical dystocia in elderly primigravida. Death occurred on same day. Diagnosis: cerebral hæmorrhage.

CASE 5665. Patient, aged 30 years, nullipara. Emergency admission made in thirty-third week for acute intestinal obstruction from adhesions following previous ovarian cystectomy. A low fundal section was done and it was necessary to empty the uterus in order to release the obstruction. Death occurred on second day. Diagnosis: prematurity. Weight 2135 grams.

MORBIDITY

While the small size of this series prevents any sweeping deductions and renders futile any effort to cast percentages, a close study of Tables VI

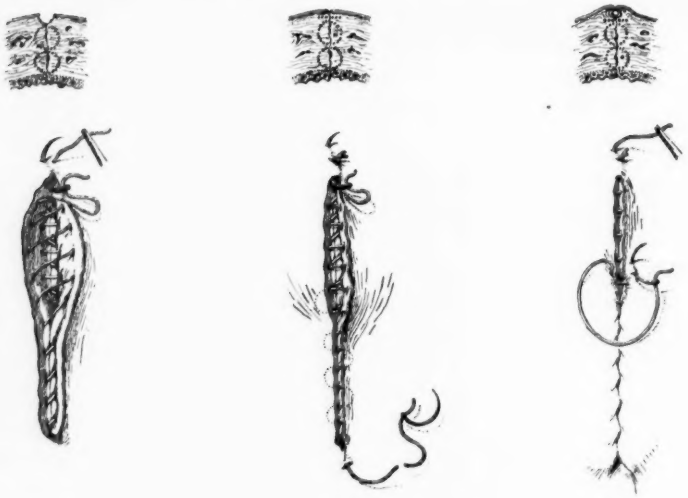

Fig. 4. Fig. 5. Fig. 6.

Fig. 4. Second tier. The same suture as in Figure 3, returning, takes in the superficial half of the muscle. The tension sutures of Figure 2 are tied at the completion of this stitch.

Fig. 5. Third tier. Continuous "subcuticular" stitch, No. 0 20 day chromic gut, for apposition of superficial wound edges.

Fig. 6. Fourth tier. Opposite end of suture shown in Figure 5, threaded upon a fine intestinal needle, for peritonealization of wound. Small "bites," close to wound edges, are needed in upper third.

and VII and of the corresponding graphic temperature charts will yield information not only concerning the morbidity of section in general, but also something about the comparative results of corporeal and cervical operations.

A consideration of morbidity takes in a number of factors which the temperature alone cannot possibly represent, such as nausea, tympanites, anæmia, wound and other complications, pelvic adhesions, effect upon lactation, effect upon future childbirth, and the like. Furthermore, the temperature charts of different clinics can find no common basis for the comparison or lumping of experience so long as conditions vary so widely locally. On the other hand, it is conceded that while the febrile record gives only a partial and in some instances an erroneous view of a case, it is at least a fair index of recovery; the patient febrile from one complication will often run the gamut of other morbidities.

We, therefore, follow the conventional method, with a protest, however, against applying a morbidity measure designed for vaginal deliveries against results in abdominal delivery. That index, in our clinic, is a temperature of 100 degrees Fahrenheit, occurring twice in any 24 hour period except the immediate 20 hours postpartum, the temperature being read every 4 hours.

In considering Table VI, therefore, the application of the above rule showed 54 of the 73 cases to be febrile, 41 of them having a temperature reaching to 100 degrees at least twice on one or more days after the third postoperative day. Of these 41, 18 were distributed among 25 cervical sections, and 22 among 44 corporeal sections, an advantage in favor of the latter operation in the group as a whole. On the other hand, the fever in the corporeal cases was more often referable to some pelvic or uterine lesion, and the average stay in hospital was somewhat more prolonged beyond the routine 16 days laid down for uncomplicated cases. With but one exception—a fatal case of peritonitis lasting 4 days—the pelvic lesions were of a minor character, none extending to the adnexa or progressing to suppuration, no positive blood cultures being returned, and the longest period of postoperative hospitalization from any cause not exceeding 34 days. A strict account of wound healing on the rather rigid schema proposed by the Woman's Hospital in

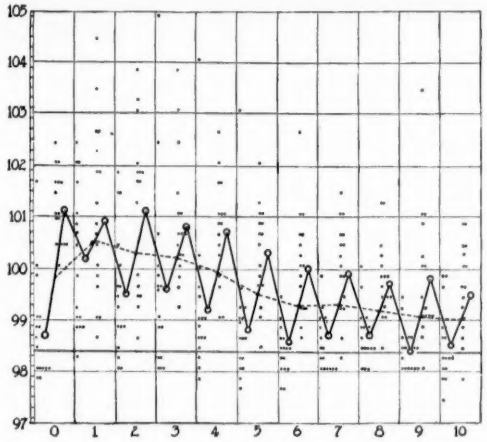

Chart 1. Extreme diurnal variations and average daily temperature after operation in 16 emergency (dystocia) fundal sections.

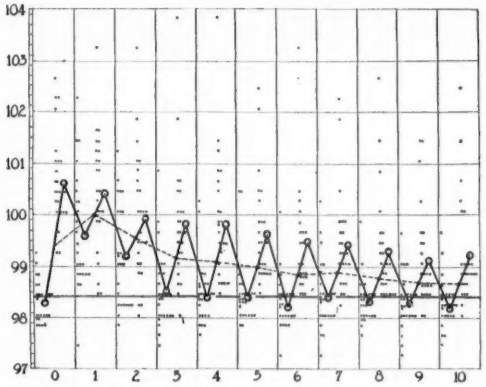

Chart 2. Extreme diurnal variations and average daily temperature after operation in 24 elective fundal sections.

New York revealed no major complications and no infections, save in the fatal case referred to. None of the cases remained hospitalized for wound complications beyond the allotted time, and to date, a re-examination of cases in the follow-up clinic has failed to discover any late defects.

Table VII recasts the febrile morbidity for cæsarean section when performed after the onset of labor. It is this group of cases which defines the acid test of safety for any given type of cæsarean section. The pre-operative conditions obtaining in the present series show an average of approximately 30 hours of labor in 32 total operations for dystocia, 30 of which were done by either the corporeal or cervical method and the remaining two by marsupialization or extra-peritoneal operations chosen as alternatives to hysterectomy in cases of frank pre-operative infection. It is significant of the clinic's experience and methods to note that in the period represented by this report there was no resort to hysterectomy at any time because of presumptive ante-partum uterine infection, although the pre-operative temperature ascribable to such infection alone reached peaks of over 100.6 (in two cases 101.6) degrees in 5 of the 30 cases of Table VII, and the length of time the membranes were ruptured exceeded 48 hours in 3 cases. Eleven of the 30 cases were frank emergencies, and, in the remaining test labors, an additional 9 had been in labor for varying intervals under other supervision before admission to the hospital. As previously noted, however, the only attempts at vaginal delivery prior to operation, 5 in number, were conducted in hospital. Since the choice of operation in 30 of the 32 total operations for dystocia lay between the cervical and corporeal routes, the data are classified in Table VII to show the conditions and results under these two procedures. It is when so considered that the slight superiority of the cervical type of approach in these cases is demonstrated. While there was one mortality in the cervical group and none in the other, the results in the various morbidity factors were somewhat better for this operation than for the corporeal, in spite of a generally less favorable class of risk beforehand.

Perhaps the morbidity of recovery is more strikingly illustrated in the graphic temperature records. These were constructed to show the average pre-operative temperature, the average peak temperature at the end of each 12-hour post-operative period to the beginning of the second day, and thereafter the average low and average high temperature for each day up to the tenth. Differences here tend to iron out so consistently in such an averaging of data that the seemingly minor differences in the averaged totals are more significant than would at first appear to be the case. The charts may be read in a number of ways, one of which is to note the date at which the average temperature for the day falls below 99 degrees. The better records are naturally in the elective groups, as compared to the dystocia groups. On the other hand, within the elective groups alone, the records of the conservative operations are superior to those of the cervical and constitute the best convalescences of the

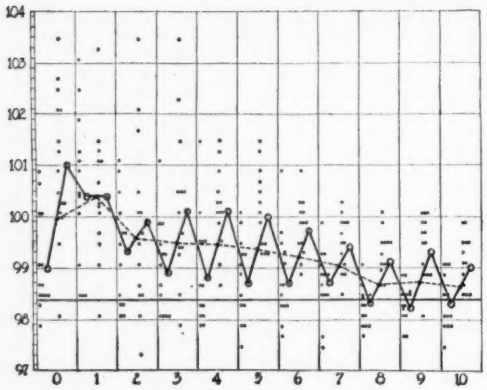

Chart 3. Extreme diurnal variations and average daily temperature after operation in 14 emergency (dystocia) cervical sections.

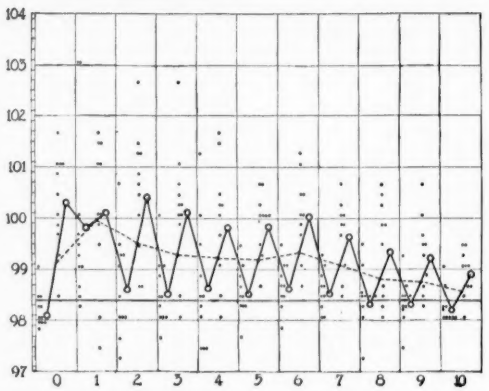

Chart 4. Extreme diurnal variations and average daily temperature after operation in 11 elective cervical sections.

series. In the dystocia group, however, the cervical records, while not differing much from the cervical type of convalescence in elective operations, are superior to the corporeal records in this type of case. In all the charts a considerable immediate postoperative reaction is apparent, partly as a consequence of the use of general anæsthesia, long operative time, and the burying of much catgut.

FOLLOW-UP DATA

While 59 of the 70 surviving cases have been examined at intervals of from 6 weeks to 28 months after operation, there is no late morbidity attaching to cæsarean section in general, or as between the types of cæsarean section, which is not characteristic of the average gynecologic section, except in the matter of subsequent pregnancy. There were no defects as to wound, and no disabilities due to pelvic infection, bladder distortion, varicosities, and similar conditions. There were several temporary irregularities of menstruation, noted only in cases in which this function was re-established shortly after operation (failure to nurse the infant). These could usually be traced to a distortion of the uterine body by suspending adhesions, and in any event, no cases have remained permanently disordered or altered. With respect to future childbearing, the series is admittedly too recent to yield anything of value. Five of the cases in the series have been delivered twice in the period under consideration, 3 by a second cæsarean section included in the total of 73. One other has since delivered spontaneously, and the remaining case has had a cæsarean section in another hospital.

SUMMARY

A comparative analysis of our results in cervical, as contrasted to corporeal cæsarean section, would appear to justify the following comments:

When the conservative operation is performed through a low uterine incision, the same being carefully sutured, there will be found to be little difference in immediate convalescence as contrasted with that of the cervical section, if both are done as elective operations before labor. After the onset of labor, there will be some advantage as to safety, febrile morbidity, and other factors of convalescence in favor of the cervical section. The advantage in our hands up to this time has been so slight, however, that, while hesitating to recommend a stand which would be at odds with newly reported experience in other quarters, we believe that there is yet hope for increased safety in the relatively simple corporeal operation after the onset of labor. While no assurance of safety in section removes the necessity for good obstetric judgment in the conduct of cases of questionable disproportion, surgeons who now resort to elective section in preference to the risks of operation late in labor, or because of the difficulties of the cervical section, may, by following the suggestions outlined, find it possible safely to employ test labors more frequently. By so doing, they may find, as we have found, a further gratification in a diminished necessity for resort to section generally.

As for the thesis now advocated that the cervical section should replace the corporeal operation as a routine method in all cases requiring operation, our results would suggest that the decision might conceivably be made upon other grounds

than the alleged greater safety and smoother convalescence of the cervical section. For the practiced obstetric surgeon there is the theoretical advantage that the scar of the cervical section, situated as it is in a quiet sector, is less apt to rupture in subsequent pregnancy and labor. We are not prepared to concede the point as proved at the present time in spite of reported figures favorable to the new operation, since we can find no figures on the incidence of rupture of fundal scars as low in the anterior wall as ours are. On the other hand, for the surgeon faced with the problem of only occasionally performing cæsarean section, often under unfavorable circumstances, a consideration of some of the fundamental principles here mentioned for the improvement in execution of the simple corporeal operation may offer a safer course than recourse to a more technically formidable procedure.

Our series is admittedly too small to give these thoughts the force of conclusions. We are still engaged in a study of the subject and offer our preliminary experience as a discordant note in a chorus of praise for the cervical section which perhaps has as many potentialities for harm as for good. It is our hope that students of maternal mortality may be led to re-examine their own further experience in the light of these considerations.

EXTRA-ARTICULAR FIXATION OF SACRO-ILIAC JOINT

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IN 1926 Verrall published the description of a method of fixation of the sacro-iliac joint by means of an extra-articular bone graft. This method consists essentially of preparing an autogenous graft taken from the crest of the tibia and inserting it through the bases of the posterior superior iliac spines and in contact with the posterior surface of the sacrum by removal of the spine of the second sacral segment. This graft, after becoming fused at the three points of contact mentioned, should persist with adequate structural integrity, in accordance with Wolff's Law (2), to withstand the strains of traction and tortion incident to any motion in the sacro-iliac joints. A comparatively simple and satisfactory method of dealing with intractable cases of disability due to sacro-iliac arthropathy should require no lengthy description of its utility and indications in view of the mass of literature dealing with the subject.

The technique of the operation as originally described, except for one minor modification, has been used in our clinic. The exposure is through a curvilinear incision, with convexity upward, which connects two points located approximately 3 centimeters below and lateral to the posterior superior iliac spines. The flap is turned down thus exposing these processes and the erector spinæ masses between. Longitudinal incisions are made through the periosteum over the iliac spines and the first and second sacral spinous processes and these structures are then cleared with a periosteal elevator. The erector spinæ masses are next freed sufficiently below to permit the passage of the graft. The bases of the iliac processes and the intervening sacral spine are then drilled transversally. The drilling of the base of the sacral spine, instead of its removal, constitutes the minor modification of the original technique. The use of a drill of sufficient length to connect both iliac processes has been found to facilitate the preparation of the tunnel for the graft. The point of the drill may be directed with the finger after it penetrates the base of the first iliac process so that it will not injure the erector spinæ masses and also so that it will proceed directly through the base of the interposed sacral spine to the opposite iliac process. The excavation in the iliac processes may be enlarged if necessary with a gouge or osteotome, but little difficulty will be experienced in seating the graft due to the cancellous character of the bone, if the three openings are properly aligned.

A graft taken from the tibial crest of approximately 12 millimeter width and length determined by measurement is now inserted at the base of one iliac process and tapped into place with a mallet. The medullary side of the graft is placed downward to facilitate fusion over the sacrum. The drive fit of the graft maintains its position without other fixation. The wound is then closed in the customary manner. A bed is prepared with a fracture board or Bradford frame and the patient placed in a prone position

Fig. 1. Exposure and method of inserting graft.

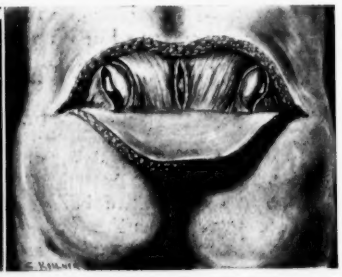

Fig. 2. Graft in place.

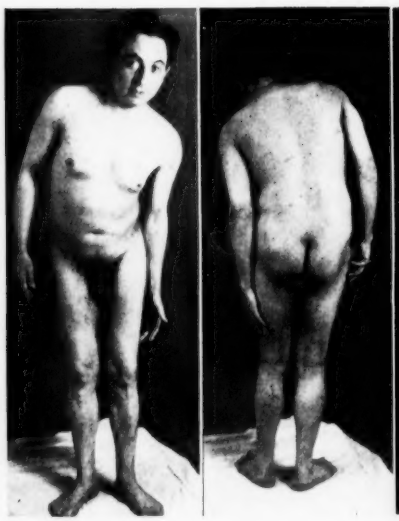

Fig. 3. Case 1. Patient's habitual posture before operation.

Fig. 4. Case 1. Photographs on discharge.

Fig 5. Case 1. Radiograph of pelvis showing graft one month after operation.

Fig. 6. Case 1. Radiogram showing graft one year after operation.

Fig. 7. Case 2. Radiogram showing graft 3 months after operation.

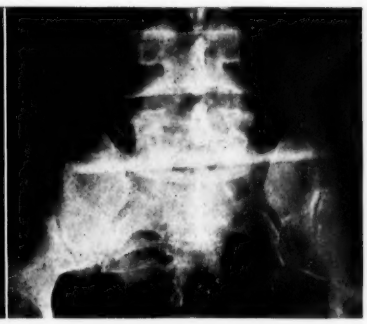

Fig. 8. Case 3. Radiogram showing graft 6 weeks after operation.

which is continued until the sutures are removed. The period of recumbency depends on the character of the case in point. In any case not involving a destructive process in the sacro-iliac joint, active flexion and extension of the knees and hips may be started in bed after 3 weeks and gradually increased, provided there is no associated discomfort. When the motion in hip joints has become comparatively free and painless, the patient may be allowed to get up.

The preceding method was used in our clinic in three consecutive cases of intractable sacro-iliac pain in which there was no radiographic evidence of gross pathology. These patients all returned to their customary manual labor within four months and reported symptom free after one year.

One of the accompanying illustrations shows the graft in position one year after operation.

ADVANTAGES

As pointed out in the original paper, the extra-articular graft or tie beam method of fixing the sacro-iliac joint has several advantages:

1. It is a correct sacro-iliac support from a mechanical standpoint.
2. The procedure is comparatively simple.
3. In tuberculosis it does not involve opening the joint.

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2. Die Lehre von der functionellen Pathogenese der Deformitaten. Arch. f. klin. Chir., liii, Heft 4.

SINGLE INGUINOSCROTAL INCISION FOR DOUBLE HYDROCELE OPERATION

Or Hydrocele on One Side and Inguinal Hernia on the Other

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IN performing the radical operation for hydrocele, some surgeons prefer an incision extending over the lower inguinal and upper scrotal regions. The skin, dartos, intercolumnar, cremasteric, and infundibuliform fasciæ are incised down to the parietal layer of the tunica vaginalis. The hydrocele is delivered into the incision by means of external pressure on the scrotum. When necessary the sac is freed from the scrotal coverings by means of a gauze sponge or by blunt or sharp dissection. I have used a unilateral inguinoscrotal incision in operations upon eight bilateral hydroceles and upon three patients who had a hydrocele on one side and an inguinal hernia on the other. If the hernia and hydrocele are on opposite sides, a full length herniorrhaphy incision is made on the side of the hernia. The incision is extended downward on the anterior surface of the scrotum as far as may be necessary to deliver the hydrocele on the other side. The hernia is repaired first. The hydrocele on the side opposite the hernia is delivered as follows: the scrotal septum is incised and the tunica vaginalis is freed from the scrotal attachments. As a routine measure I prefer to drain by making a small counter incision through the lower scrotal wall. I omitted drainage in some cases and the results were good.

It is a sound surgical principle that any given operation should be accomplished with a minimum amount of operating. The plan to remove a bilateral hydrocele through one incision eliminates the making and repair of the customary double incision, and thereby saves time and minimizes the amount of operating.

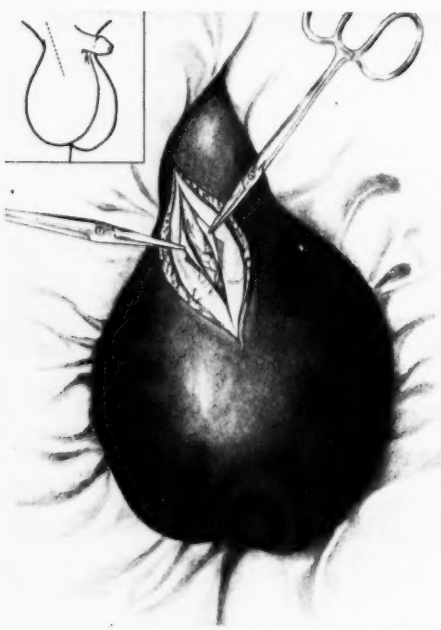

Fig. 1. Showing line of incision for operation on bilateral hydrocele.

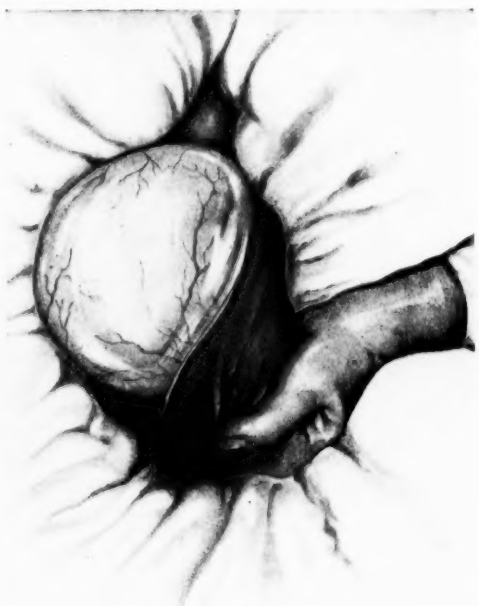

Fig. 2. The right side has been repaired by the usual Jaboulay technique, and the left hydrocele is being delivered through the original incision by external pressure.

Briefly the technique of single incision for the radical cure of bilateral hydrocele may be described as follows:

1. An incision is made over the lower inguinal and upper anterior scrotal regions.

2. The hydrocele on the side of the incision is delivered and the conventional sac-everting operation is performed. (In large hydroceles part of the sac is resected.)

3. The hydrocele on the opposite side is pushed toward the incision, the scrotal septum is incised, and the hydrocele delivered through the opposite inguinoscrotal wound where again the usual "bottle" operation is performed.

4. The testicles are placed in their proper scrotal compartments; the septum is repaired; and the wound is closed with or without drainage. Absolute hæmostasis is essential.

TREATMENT OF CONGENITAL DISLOCATION OF THE HIP BY A NEW METHOD[1]

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THE author made a report on the treatment of congenital dislocation of the hip in this journal[2] almost 20 years ago. At that time he described a method by which he attempted to eliminate the use of plaster of Paris, this being probably the first attempt in the history of the subject to do away with that medium. Instead of plaster of Paris, he used a framework made of metal bands one inch or so wide, enclosing the pelvis and thigh, with a connecting band running down the side. The bands were very carefully padded and like a plaster encasement the whole thing was given the shape and position required by the angle made by the thigh with the trunk after reduction. This mechanism was, of course, prepared and fitted as far as possible, beforehand, so as to be ready to apply immediately after the reduction of the hip.

The author believed that there were distinct advantages in this method of treatment, viz., the speed and neatness of application of the apparatus, the possibility of its accurate adjustment, and the great gain in cleanliness of the enclosed parts owing to improved ventilation. Nevertheless, as it happened, this method had to be dropped, first, because of the quick onset of sloughs from the pressure of the bands in spite of the thick padding, which pressure could not be controlled, and secondly, because of the failure of the mechanism to hold the joint reduced. Then for the time being, the author returned to the use of plaster of Paris.

However, in recent years, after his return from overseas, the subject was again taken up but in a different and much more serious vein because it had now come home to him, and this point was entirely missed originally, that there was an advantage brought out by the non-plaster treatment which could never be hoped for by the plaster method. This point was of such tremendous importance that he could not escape the responsibility of reconsidering the subject and attempting to develop a new technique which would overcome the difficulties encountered in his earlier experience. The point of great advantage referred to, is that with the old method of using plaster, treatment has to be postponed until the child is old enough to control urination, else the plaster encasement becomes soaked with urine and is ruined. This usually means that the child has to be 3 or 4 years old before beginning treatment. With the non-plaster treatment, if a retaining apparatus could be developed which is not damaged by urine, treatment might be instituted immediately on recognition of the condition no matter how young the child, which usually means as young as 14 to 16 months. Naturally then reduction is a comparatively simple affair, whereas at the age of 3 or 4 years it is not.

With these facts in mind, the author finally succeeded in developing such an apparatus which, he believes, eliminates the shortcomings of the earlier ones, and the object of this report is to describe his present procedure.

THE RETAINING APPARATUS AS NOW USED

The retaining apparatus is made to include both limbs in every case, even if only one is involved. There is first of all, one large abdominal cuff at least 5 inches broad which incloses the lower part of the trunk, extending down in front as far as the bent thighs permit, and carried far down behind over the back of the buttocks so as to support the tuberosities of the ischia and the hip joints. For obvious reasons this is shaped so as not to cover the cleft between the buttocks. There are also cuffs for each thigh and upper leg, about 4 and 2 inches broad, respectively. All 5 cuffs are made of aluminum which is faced on the skin side with felt at least one inch thick, the whole being enclosed in the usual brace covering. The cuffs are fastened to the enclosed parts with straps and buckles.

The other feature consists of two connecting iron posts, one on each side, which holds the cuffs in the desired relationship. These are of ¼ inch square stock, untempered, and pass through boxes fastened to the cuffs, thus permitting readjustment in position. They are held fastened to the boxes by screws. These posts must be placed somewhat posteriorly so that they may be bent into shape without encroaching into the angles between the cuffs. There are two bends in each post, each forming approximately a right angle, one at the hip and the other at the knee.

In fitting, the cuffs are first applied to the parts and then the connecting posts shaped, adjusted,

[2] Surg., Gynec. & Obst., 1910, xi, 302.

[1] With the assistance of Mr. George Guilford in the Mechanical Features.

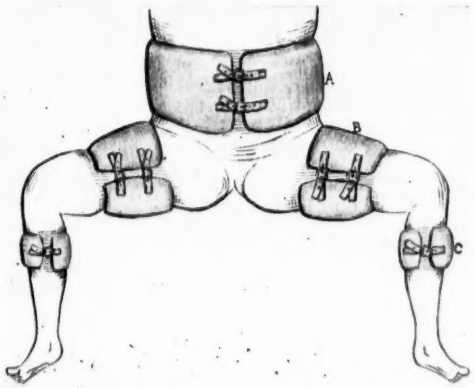

Fig. 1. Anterior view. *A*, *B*, and *C*, Pelvic, thigh, and leg cuffs, respectively.

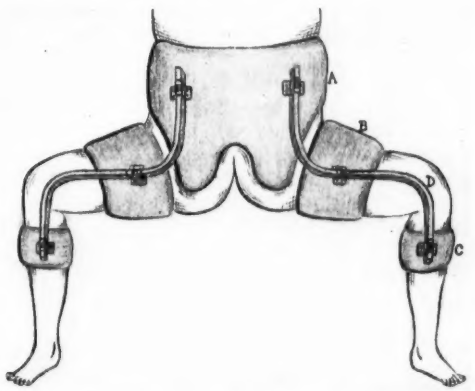

Fig. 2. Posterior view. *A*, *B*, and *C* as in Figure 1. *D*, Iron post connecting cuffs. This is of ¼ inch stock, untempered and slides through boxes attached to the cuffs. A screw tightens it in each box.

and fastened where required. As in the earlier work the apparatus should be ready to apply immediately after the reduction of the hip.

The fittings, both preliminary to and after reduction, should be as accurate as possible, not only for the sake of maintenance of the position of the thigh, but also to distribute pressure as uniformly as possible so as to prevent sloughs.

In using this contrivance, there are three details of special importance which should be emphasized: (1) the thickness of the padding, (2) the posterior extension of the pelvic cuff down over the buttocks, and (3) the fact that the iron posts are placed well posteriorly.

REDUCTION (FOR CHILDREN ONE TO TWO YEARS OLD)

The retaining apparatus having been prepared and fitted, one may go ahead with the reduction and in doing so may use any method he desires or to which he is accustomed. But it should be emphasized that in dealing with a child a little over a year old, one is dealing with very delicate structures and the greatest care should be used to avoid breaking the bone or stretching the artery or nerve unduly. For this reason, the author offers his own technique as it permits the handling of the parts with comparatively little traumatization.

The method is briefly as follows: After the patient is anæsthetized, the thigh and knee are flexed, the limb being grasped at the ankle, and then with a circular, prying motion, a preliminary attempt is made to place the head over the socket, the approach being made from behind. This is repeated and if the adductors are very tight, they should be stretched or tenotomized so that they offer no resistance. After the manipulation is carried out a few times, one obtains a slight 'click' at the joint which is felt more than heard. Once obtained, the exact manipulation which brings about the click is repeated until the click becomes plainer. This should be repeated again and again until eventually a distinct sharp movement of the head takes place instead of the click, this being the entrance of the head into the socket. The manipulations are repeated until stability is reached so that the head stays in its new place even when moderately large movements of the thigh are made to test it. After stability is gained and maintained, it is probably noted that the thigh is practically at a right angle to the central longitudinal line of the body. Then apply and carefully refit the prepared apparatus and take roentgenograms with the patient stil under the anæsthetic. If a reduction is shown that is all there is to do, the apparatus simply being left on. If the hip is not reduced according to the roentgenogram, one may repeat the manipulation perhaps several times, until the result desired is achieved.

In all the proceedings as already noted, no great force is used and the time required for the reduction should not be over 15 minutes. The adductors having been stretched and tenotomized, they will offer no resistance but to be sure of their complete stretching it may be wise to elongate them further by striking their tendons near their origin with sharp but not too forceful blows with the outside of the hand.

If, in spite of careful technique, roentgen pictures show no or incomplete reduction, one should be satisfied for the time being. Occasionally, if the apparatus is simply left in place, the head will spontaneously slip in itself after a time, or it will improve its position. Even if this does not occur, the chances are that in anæsthetizing again, say 2 weeks later, a complete reduction will be obtained with ease.

It may be well to repeat that whether one or both hips are dislocated, both hips should be included in the retaining apparatus in every case, not only for the sake of stability but also so as to be able to compare the two sides. After reduction the child is put to bed.

STAGE OF CONVALESCENCE AFTER REDUCTION

In this stage of treatment, the aim is simply to get the child back on its feet and consists in leaving off the apparatus while the child is still in bed, for increasing periods of time each day beginning about the fourth or fifth month after reduction.

In some cases it might perhaps be wise to bring down the thighs gradually while the apparatus is still being worn, which is accomplished by straightening the iron posts at the hip angles a little more every few days. The author, himself, does not use this measure, preferring to loosen the patient's joints after the apparatus has been taken off for good. But in no case should the child be placed on its feet while still wearing the machine. Passive motion applied by mother or attendant each day should soon obliterate the stiffness, and if necessary one may resort to a manipulation under ether. In this stage frequent measurements should be made and an occasional roentgenogram should be taken to control other observations.

PROGNOSIS

This report is presented as carrying with it only the importance of its face value. The number of cases on which it is based is not large but the last 5 cases treated have resulted in complete cures and 4 of these were only a little over a year old when treatment was started. It is true that it might have been better to have waited until a larger series of cases could have been thus treated. However, this would have meant a delay of several years before a report could have been published, and it seemed wiser to the writer to give others the benefit of his experience and good results thus far even though the number of patients treated is small.

In passing it may be well to state that it has not seemed necessary in this paper to describe individual cases, as one case is hardly distinguishable from another and a hip reduced very quickly takes the characteristics of a normal hip. Photographs of patients have also been omitted, for in the last analysis credibility is a personal matter of statement and requires no circumstantial evidence to be convincing.

The method of treatment here described is the result of many years of study, the writer's first acquaintance of the subject dating back from his out-patient days at the Boston Children's Hospital almost 30 years ago and includes experience in many foreign clinics. As this method evolved itself step by step and finally crystallized into its present concrete shape, the age for beginning treatment became lower and lower and the prognosis better and better. The writer believes that the majority of patients, perhaps all patients if treated early enough, will be completely cured and finally that this cure can be brought about in less than one-half the time required by the older methods.

EDITORIALS

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OCTOBER, 1929

THE CLINICAL DIAGNOSIS OF INTRA-ABDOMINAL MALIGNANT DISEASE

SEVERAL benign intra-abdominal lesions simulate malignant disease so closely that differentiation before operation is difficult. A large ovarian fibroma in a young adult is frequently accompanied by ascites, a combination which may lead to a hasty and erroneous diagnosis of malignancy.

Recently, in the case of a middle-aged woman, a protuberant abdomen distended with fluid and an indistinctly palpable indurated pelvic mass made a clinical diagnosis of papillary carcinoma of the ovary with ascites almost a certainty; yet the fluid was found to be encapsulated in a huge, benign ovarian cyst entirely filling the abdomen; the irregular pelvic mass was due to small uterine fibromyomata which had been impacted in the pelvis by the pressure and the weight of the ovarian cyst.

In a case in which exploration was performed for a bleeding lesion of the right kidney, the abdominal distention was found to be caused by a huge hydronephrotic sac. The bleeding originated in a papillary carcinoma of the renal pelvis. Although prior to operation the unilateral renal bleeding and the abdomen distended with fluid seemed to point to extensive malignant disease, the lesion was found at operation to be localized and operable.

A stony mass was palpated in the region of the prostate gland in the case of a patient who had complained of urinary dysfunction for a comparatively short time. Carcinoma of the prostate gland was strongly suspected. Roentgen-ray examination of the urinary tract showed that the indurated mass was a huge urinary concretion, pyramidal in shape, occupying the exact position of the prostate gland; removal of this stone relieved the urinary obstruction.

A diseased gall bladder in an elderly patient sometimes interferes with the neuromuscular control of a segment of stomach to such an extent as to lead to the erroneous pre-operative diagnosis of gastric tumor. If the symptoms are pronounced and the involvement extensive, surgical removal might be despaired of; yet at operation it may be discovered that the disturbance of motility centers around a diseased gall bladder in an otherwise normal gastro-intestinal tract.

Such are examples of the similarity between the pre-operative clinical manifestation of benign and malignant intra-abdominal lesions. They illustrate how guarded should be the pre-operative clinical diagnosis of malignant disease in the abdomen and how unwise it is to despair of the prognosis before the exact nature and extent of the lesion is revealed.

WALTMAN WALTERS

LIVER REGENERATION

THE idea of liver regeneration comes down from antiquity. Upon it is founded the myth of Prometheus whose punishment for bringing fire to man was that a vulture sent by Jove should each day feed upon his liver. Hildamus, in the second century, was the first to mention the repair and healing of liver wounds. Cruveilheir suggested the possibility of liver regeneration in 1830.

Clinical and experimental evidence have both pointed the way. Pathological lesions of the liver, such as subacute yellow atrophy with its subsequent "nodular adenomatous hypertrophy," have demonstrated this inherent ability to restore itself.

This capacity for regeneration has been shown experimentally by damaging the liver with toxic substances such as chloroform or phosphorus, or by removing large portions surgically. This latter method is simple, graphic, and convincing. The single objection to it is that restoration of liver tissue does not occur at the pedicle from which it was removed and so does not fall within the biological definition of "regeneration" which demands that regeneration take place at the site of removal. The restoration is confined to the remaining lobes which hypertrophy that they may contain the regenerated lobules, newly formed to replace those in the excised portion.

Sixty-five to seventy-five per cent of the dog's liver is easily excised. Within two short weeks, this remnant closely approximates the original weight and volume. Six more weeks must elapse before the normal liver histology is restored.

The chief cellular activity is at the periphery of the lobules. Here mitotic figures may be found 2 days after partial liver removal. The hepatic cells are the chief source of new liver tissue but the bile ducts play a definite rôle by sending forth buds of proliferating cells. The transition from these proliferating duct cells to new hepatic cells is extremely gradual. The process closely resembles the embryonic development of the liver. The stress of regeneration seems to have caused a reversion to the primitive mode of production of hepatic cells in which the undifferentiated biliary capillaries give rise to new hepatic cells by dichotomous branching.

Eight weeks after partial hepatectomy, the newly formed hepatic tissue cannot be distinguished from normal liver. The old lobules do not hypertrophy but undergo a hyperplastic budding process at their periphery, productive of new lobules so similar in size and shape as to be indistinguishable from the old. Here again the analogy to the embryological development of the liver is evident.

Of greater interest is the apparently infinite capacity of the liver to restore itself. Even after a second or third partial liver removal, the remaining portion restores itself to an approximation of normal. As before, the regeneration is confined to the remaining lobes which undergo a tremendous hypertrophy, but the resulting tissue is normal hepatic parenchyma. After repeated partial hepatectomy, the restoration is as complete and rapid as after the first. Only technical difficulties with hæmostasis prevent further removal.

At this stage, more hepatic tissue will have been removed than the animal possessed before the experiment began. And yet, when the animal is killed, it will be found to possess as much liver tissue as one would expect to find in a normal dog of similar weight.

These animals never present a picture of hepatic insufficiency. Bile is always present in the duodenum. They thrive on a routine

mixed diet, which includes meat. The various liver function tests have shown their hepatic function to be normal at all times.

Regeneration seems to depend upon an unhampered portal circulation. For example, after making an Eck fistula which shunts the portal blood directly into the inferior vena cava, there is no restoration after partial hepatectomy. Nor does regeneration occur after the production of experimental cirrhoses of sufficient intensity to occlude the portal intake, either by ligating the common duct or by prolonged feeding of carbon tetrachloride. These procedures certainly do not lessen or destroy the need of the organism for functioning hepatic tissue. It seems likely that some other factor than functional lack is involved since restoration takes place only in the presence of an intact portal blood supply.

The liver, then, in the absence of lesions which obstruct the portal blood supply either directly or indirectly, shows an infinite ability to restore itself after repeated trauma. No other organ remotely approaches the liver in its capacity for regeneration.

F. C. FISHBACK.

MASTER SURGEONS OF AMERICA

FREDERICK WILLIAM PARHAM

IN the death of Frederick William Parham, on May 7, 1927, the medical profession lost one of its ablest and most beloved surgeons. He was born in New Orleans on March 20, 1856, the son of John Greenway and Mary Blount Parham. His early education was received in the public schools of his native city and his collegiate work done at Randolph Macon College of Virginia. He studied medicine at the University of Louisiana, now Tulane University, and later did post graduate work in Philadelphia.

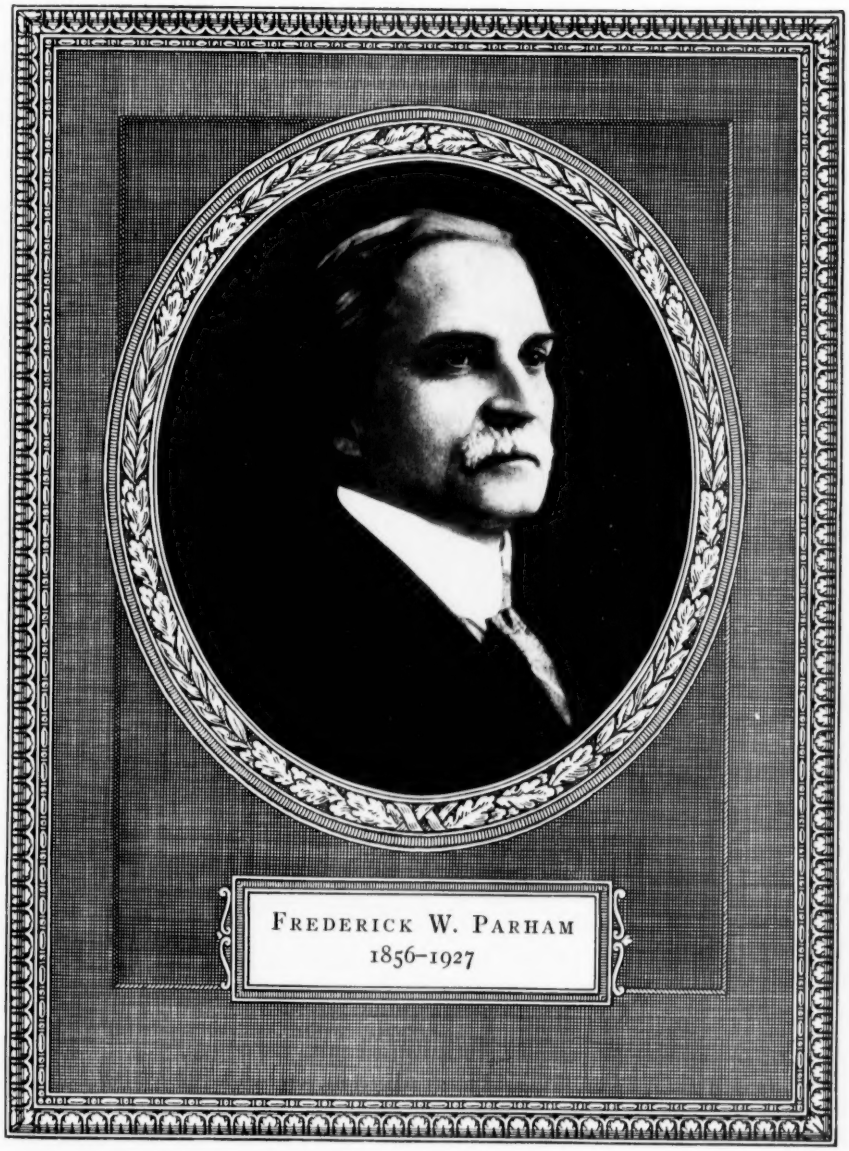
Essentially a scholar, a student not only of medicine, to which he devoted his life, but a lover as well of art and music. He had a keen analytical mind and sound medical judgment. It was his great devotion to surgery and his untiring efforts to improve this branch of medicine which inspired his associates to greater deeds, and it was their co-operation which had much to do with firmly establishing aseptic surgery in the wards of the Charity Hospital of New Orleans.

The history of his life's work would be incomplete without a short sketch of his accomplishments in this great institution, for it was here he spent his spare moments and gave freely of his time, not only for the advancement of surgery, but to the establishment of new regulations in the management of the hospital tending toward the improvement of standards and the betterment of the staff.

It is astonishing that a man of such frail physique could accomplish some of the herculean tasks he undertook, for in those days reforms were slow to introduce and accepted only after convincing proof. From the time he entered the hospital as an interne in 1877, a position he won in competitive examination, until his death fifty years later, his interest never ceased.

It was through his direction, while assistant house surgeon 1885–1887, that a system of antiseptic methods was established in the obstetrical wards, which practically eliminated the scourge of puerperal infection from this department.

In 1889, immediately after his return from the European clinics where he studied under such masters as Czerny, Bramann, Hohen and Ewald, and where he gained a thorough knowledge of the teachings of Lister and Pasteur, Dr. Parham established in his wards at the Charity Hospital, at his own expense, a sterilizing outfit and faithfully carried out the directions for the sterilization of hands, dressings, instruments and ligatures, as well as the preparation of pa-



FREDERICK W. PARHAM
1856–1927

UNIV. OF MICH.

tients. For this achievement he soon had the satisfaction of seeing the gospel of asepsis spread through other wards, especially by those of his disciples who were converts and who later equipped for this work, through their own efforts, services to which they were assigned. The relation of such an incident may seem strange in this era, but it was not an easy matter at that time to convince the older heads of the profession that their ideals were false. The proof, however, was so convincing that they too soon joined the ranks of the progressives.

Dr. Parham's wards were a veritable laboratory of research, and one experiment after another was tried until a satisfactory solution could be reached.

In those days the hospital was filled with chronic ulcers of every description. Relief must be given these poor sufferers, and for a long period of time leg ulcers became the absorbing question. Every form of graft was tested until it was fully demonstrated that autografts alone could be depended upon.

The mortality in compound fractures ranged as high as 70 per cent prior to the application of aseptic treatment to wounds, but once established, men who only a short while before were compelled to sacrifice a leg to save their lives, walked out of the institution with useful limbs. It was in this work that his interest in the treatment of fractures was first stimulated, and though devoid of any mechanical skill, he called to his assistance those who could supply this defect. After years of labor, and largely through his efforts, this branch of surgery progressed to the dignity of a specialty, and today fractures in the hospital are segregated and treated by his pupils who have thought it worth while to devote much of their time to this branch of surgery.

It was in the Charity Hospital that Dr. Parham did his first thoracotomy for tumor of the thoracic wall, which later made his name international.

Perhaps the greatest piece of constructive work done for the institution was the reorganization of its staff, and to none is more credit due than to this one man. This work stands today as another monument to his untiring energy and great desire to put the hospital on the same basis as other institutions of its kind in America.

In recognition of his services a life-size portrait, the gift of the staff, hangs in the library of the Charity Hospital with the following inscription: "Frederick William Parham—1856–1927—Surgeon, Teacher, Administrator, Friend."

Dr. Parham devoted much time to sanitation, and under his direction while sanitary inspector in the nineties, the first clinical laboratory was installed in the City Board of Health, where under his supervision cultures were made, and with the co-operation of the profession the mortality in diphtheria alone was reduced from 35 to 8 per cent.

Like a great general, Dr. Parham thought not of his own glorification, nor the financial benefits to be gained, but always of the great good that others might derive from his efforts. Whatever he found of benefit to mankind he gave

eagerly to the profession. One has only to read his publications to appreciate the character of the author. Although modest and retiring in the extreme, at times even diffident, he wielded an influence among his fellow men which few have ever enjoyed; he was quick to extol virtue and merit, but even quicker to condemn quackery and unethical practices. These characteristics were particularly noticeable during the more recent epidemics of yellow fever. Once the disease had been recognized he opposed concealment, believing that truth was always the better policy. In all matters of health or sanitation his advice was sought, and none was more active than he in fighting for the suppression of a disease so injurious to the good name of New Orleans. No matter what members of the profession thought of him personally, they knew that his opinion in any controversy was based upon facts and given only after convincing proof.

Dr. Parham was recognized by his fellow practitioners, not only for his skill as a surgeon, but likewise for his ability as a diagnostician. Well equipped with a knowledge of the principals of surgery and with years of experience, he was always a reliable consultant. Nor could he be persuaded to operate on any patient unless he was reasonably certain of giving relief to the sufferer.

Though honored by every association to which he belonged, these honors came unsought. He was president of the Southern Surgical Association; vice-president of the American Surgical Association; president of the Louisiana State Medical Society and the Orleans Parish Medical Society. He was also a fellow of the International Society of Surgery; he was a founder of the American College of Surgeons and served for many years as a regent of this association. At the time of his death he was consulting surgeon of the staff of Touro Infirmary and Charity Hospital. He was one of the organizers of the Graduate School of Medicine of Tulane University and professor of general and abdominal surgery in this institution from 1896 to 1914, and from 1925 until his death.

For many years he was chairman of the Medical Advisory Committee of the Board of Administrators of Tulane, and it was during this régime that many of the reforms which marked the advance of the history of the school were introduced. It was in recognition of his outstanding work as a surgeon and his self-sacrificing efforts in the interest of medicine that Tulane University conferred upon him the degree of doctor of laws, in June, 1925.

Among his most valuable contributions to the profession are "Resection of the Thoracic Wall for Tumor"; "Vesico-Intestinal Fistulæ"; "Inaccessible Vesico-Vaginal Fistulæ"; "Hypospadies"; "Head Injuries Marked by Intracranial Tension"; and numerous articles on fractures and other subjects.

His own interest was always sacrificed for the good of others. He loved his work as a means of affording relief and comfort to the poor and suffering. His good deeds alone are on record, for his ideals were the highest and noblest.

E. Denegre Martin.

ARETAEI CAPPADOCIS MEDICI
De causis & signis acutorum morborum Liber I,

Iunio Paulo Crasso Patricio interprete.

PRIMI LIBRI CAPITA, EX QVIBVS prima quatuor perierunt.

De phrenitide,	Cap. I.	De tetano seu rigore,	Cap. VI.
De lethargo, seu veterno,	Cap. II.	De angina,	Cap. VII.
De tabe,	Cap. III.	De affectibus columellæ,	Cap. VIII.
De apoplexia,	Cap. IIII.	De tonsillarum viceribus,	Cap. IX.
De accessione morbi comitialis,	Cap. V.	De pleuritide,	Cap. X.

DE ACCESSIONE MORBI COMITIALIS, Cap. V, carens principio.

*** hebetudines, vertigines, tendonũ grauitates, venarum colli repletiones & distensiones: nausea frequentius quidem à cibis, non minimè tamen & ab inedia, pusilla quædam nausea sequitur, & vberior pituitæ fit vomitus: paucis assumptis cibis fastidiunt, & crudi sunt, flatibus replentur, præcordia elata habent. Hæc sanè perpetuò comitantur. Quũ verò accessio appropinquat, splendores quidam purpurei, aut nigri, aut omnes vnà permixti ob oculos in orbem versantur ac discurrunt, vt in cælo iris prætenta esse videatur: aures sonant, fœdum odorẽ sentiunt, iracundi fiunt, bilis præter rationẽ accenditur. *Quibusdã igitur cõcidendi causa, angor animi fuit: aliqui intẽdẽ fluminis decursum, aut rotam quæ circunuoluitur, aut turbinem qui in orbem agitur, cõspicati, alios autem rerum graueolentia, vt gagatis lapis odoratus, prostrauit. his vtique in capite vitium inhæsit, atque inde noxam inferens omnia habet. Nonnullos verò & corripit à neruis procul à capite positis incipiens, quicunque principium in consensum affectus inducunt. Itaque magni manuum aut pedum digiti conuelluntur: vnde & dolor & stupor & tremor sequuntur. atque hæc in caput impetũ faciunt, si & malum surrepẽs caput inuasit. His porro fragor quidam redditur perinde acsi ab ligno aut lapide verberen turquãmque ab humo surrexerunt, quædam tanquam si exinsidi s vapulassent. commemorant. Hoc sanè pacto illi quibus primò id malũ incidit, decipiũtur. Quibus verò familiare & consuetum est, simul atque morbus in digitum impetum dedit, aut alicunde exortũ est, *vsitatos, qui adsunt, adiurores inclamant, futurãmque ab experimento calamitatem prospiciunt: obsecrant quoque vt membra vnde oritur, constringant, reflectant, dirigant. quinetiam ipsimet sibiipsis affectæ membra, tanquã inde morbum eximentes, trahunt vellũtque: atque ita sibimet auxiliantes, nonnunquam & nos ad ægritudinis notitiam impulerunt. Nonnullos vtique ceu inuadente fera pauor corripuit, aut adumbrationis opinio incessit, atque ita prociderunt. At in ipso morbi insultu sensibus captus homo ilicet manus ipsi neruorum distentione cõuellunt: cura verò non solùm distracta sunt, sed etiam huc atque illuc à tendonibus projiciuntur. Id genus calamitas singulatim fœtis haud absimilis est: cervix incurvatur, caput verò distorqueatur. siquidẽ nonnunquam prorsum ceu arcus inflectitur, quando pectori maxillam adnexerit: nonnunquam verò in scapulas refringitur. Veluti iis qui per vim crinibus trahuntur, vsu venit: quando quidẽ in hanc, modò in illam partem ad humeros commouentur. Sic laborantes, magno hiatu os aperiunt: id flexum habent, linguam prælongam, vt periculum sit ne aut magno vulnere lacerent, aut penitus abscindant. Interdum convulsione dentes inter se colliduntur: oculi inuersi sunt: palpebræ cum palpitatione frequenter dehiscunt. quòd siquando coniungere velint, palpebræ nõ commiscentur, sed alba oculorum cernuntur, ac subapparent. Supercilia nonnunquam (vt iis qui ad iram concitantur) in glabellam contrahuntur: nonnunquam ad tempora vehementer admodum reuelluntur, vt curis circa frontem valde prætenta fit, atque in superciliorum medio ruge euanuerint. Malæ rubentes palpitant: labia interdum quidem in acutum clauduntur, interdum verò ad obliqua dilatantur, quando in ridentis speciem dentibus circumtenduntur. Malæ rubent quidem, sed quũ morbus increuit, & faciei liuor accedit. Ceruicis vasa distenduntur: vox, vt in strangulatu, suffertur etiamsi vehementer inclames, non sentiunt. Eorum vox nihil nisi gemitus & suspirium est: respiratio verò suffocatio quædam est, veluti in iis qui laqueo strangulantur. Inter initia, arteriarum motus vehementes sunt, & celeres, & parui: in fine verò magni, tardi, & languentes, in vniuersum autem, ordine carentes. Panis quoque arrectio sequitur. Hæc vtique circa accessionis finẽ patiuntur. At vbi ad mali remissionẽ peruenitum, tunc sponte vrinam reddunt, aluus fluit: nonnullis etiam, adstrictis compressisque vasculis genitura excernitur. Id verò & dolore intricante, & humiditate erumpẽte accidere potest: siquidem & iis neruorũ dolores fiunt. Ad hæc os vehementer humidum habent, pituitam multam, crassam & frigidam: eam si erahas, in longum veluti filum multitudinem ipsius deduces. Porro temporis longitudine & laboris vehementia, quæ intra pectus sunt, feruere spiritus verò intus coercitus omnia concutit: eorundem quoque & conuulsio & perturbatio sequitur. Inter respirandum præterea humores & os & nares inundant, spiritus cum humore effertur. Quum præcedens verò strangulatio remittit, omnia item remittere videntur. Quinetiam, vt magnis procellis concitatum mare, spumam ore profundunt: quando & tanquã iamdudum expulso morbo respirẽt, & refuigunt. Cæterùm quũ à morbo quiescunt, ab initio membris segnes sunt, capitis grauitate premuntur: dissoluti sunt, languidi, pallentes, constertati animo: ob lassitudinem morbique verecundiam conspectantur.

DE TETANO SEV RIGORE, CAP. VI.

TEtani, musculorum qui in maxillis sunt & tendinum distentiones sunt, dolorem quidem magnum inferentes, celerrimè verò necantes, haud facilè quoque sanabiles. At noxæ ab hoc malo cum omni corpore communicantur. omnia enim cum principiorum vitiis consentiunt. Species verò conuulsionis tres sunt, quæ rectum corpus riget, aut retrorsum flectitur, aut prorsum versus incurvatur. Recto quidem corpore, τέτανος dicitur, quæ neutram in partem detortus habetur atque inflexilis conspectus est. At conuulsiones, quæ recorsum aut in priorem partem sunt, à rectione & loco nomenclaturã accipiũt. Nam in anteriorem partem agitatæ reclinationem, ὀπισθότονοι vocantur, reteti qui eo loci sunt, male affectis ὑπερόπιστοι autem, si in priorem partem homo delectitur, neruis anterius positis laborantibus. ὄφις enim neruorum tortionisque vocabulum est. Causæ quæ illarum infinitæ sunt. nam ob vulnera fieri solent, ea quæ nerua, aut musculis, aut neruis punctis, ex quo plerunque contrahuntur. à vulnere enim cõuulsio, lethalis est. Conuelluntur autem & ex aborsu mulier, verùm & hæc rarò admodum euadit. & ab aliquo vehemẽti ceruicis ictu nonnulli conuelluntur: & frigus asperrimum horum virorum causa esse potest. Quapropter hyẽs omniũ maximè horũ vitiorum ferax est. Siccitas loco ver & autumnus sunt. autem minimè, nisi vulnus præcesserit, aut peregrinus morbi grassentur in vulgus. Mulieres sanè magis quàm viri, neruorum distentione correptæ: frigidæ enim sunt, verùm ipso

THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

ALFRED BROWN, M.D., F.A.C.S., Omaha, Nebraska

ARETÆUS, THE CAPPADOCIAN

OF the life of this distinguished physician of the early Christian era nothing is known. Even the exact period during which he lived is uncertain and can be determined only by inference. In the Greek manuscripts of his work he is referred to always as Aretæus, the Cappadocian. Consequently he was probably a product of that far eastern country lying north of Mount Taurus and west of the Euphrates which passed from being a part of the Persian Kingdom to the position of a semi-independent state by favor of Antony and Octavian and finally, on the death of its ruler Archelaus, was reduced to a province of the Roman Empire by the Emperor Tiberius in the first quarter of the first century of the Christian Era. We can gather from his writings that he probably lived in Rome for he prescribes the favorite Italian wines of the early Christian period, and this would place him some time after his country had become Romanized, for a citizen of an unfriendly nation would hardly go to Italy to remain, and if he were in far off Cappadocia he would probably not prescribe Italian wines for his patients.

As to his exact period the hypothesis given by Francis Adams in *The Extant Works of Aretæus, The Cappadocian*, London, 1861, is most interestingly worked out and probably correct. Adams states that it became the rule in the age of Quintilian for contemporary authors to ignore the existence of one another, particularly if they were writing on similar subjects. Searching the works of Aretæus one finds that there is a great similarity between his work and that of Galen. Their ideas are much the same. Their opinions and knowledge of the pulse coincide. They prescribe the same simples and in some instances the same compound medicines for the same conditions. The anatomy taught by each of them agrees with that of the other. Above all, each patterns after Hippocrates and shows considerable knowledge of the Platonic philosophy. So Adams says: "Altogether then, there is such a conformity between both their theoretical and practical views in their profession as we never find to exist except between authors who lived in or about the same period." The great difference between Aretæus and Galen is that they wrote in different Greek dialects, Aretæus using the Ionic and Galen the Attic. Whether this was only an evidence of dialectic or literary taste, Aretæus preferring the Homeric poems and Galen the Athenian drama or whether being contemporaries and surely rivals they preferred to ignore each other even so much as to write in different dialects is purely a matter of opinion. It would appear, however, that Aretæus was a contemporary of Galen and flourished somewhere about the latter part of the second century A.D.

Judging from what we now have of the writings of these two men Galen was by far the more prolific writer, but whether this is fact or only that more of Galen's work remains to us is only a guess. Aretæus did write more than has been found for he refers to a surgery that he had written of which we have no trace, so we are left in the dark as to the actual amount of writing done by this prominent physician and surgeon.

Aretaeus is referred to by only a few of the writers of the Byzantine period and was wholly neglected by the Arabians. He did not appear to be popular and even in the early Renaissance nearly all of the older Greek authors were translated into Latin and published before his works were taken up, translated by Junius Paulus Crassus, and published in Venice in 1552. Crassus says in his preface, dedicated to the Illustrious Prince Albert, that the manuscript ("In the front of the book the name of the author was written, Aretæus, called the Cappadocian") was in poor condition and fragmentary when it fell into his hands and he believed it should be translated and saved for posterity. The work was reprinted in 1554 and in 1557 this translation by Crassus is the first work printed in the *Medicæ Artis Principes* of Stephanus. From that time on the work of Aretæus was reprinted frequently. It was translated into English first in 1785 by Moffat, again in 1837 by Reynolds, and in 1856 the translation by Francis Adams was published by the Sydenham Society.

Aretæus wrote on the causes and symptoms of both acute and chronic diseases and the therapeutics of both. He describes tetanus, quinsey, ulcers of the tonsils, and pleurisy. He includes empyema and abscesses of the lungs among the chronic diseases rather than the acute. He writes of vesical stone and advises perineal cystotomy but gives no detailed directions as to the method of operation. The same neglect of surgical technique is found in all this, his medical work, and it is extremely unfortunate that his surgical treatise, to which he refers, has been lost.

REVIEWS OF NEW BOOKS

THIS volume on *Teeth and Jaws Roentgenologically Considered*[1] should be very useful to the dentist who makes his own radiographs, for the reason that it outlines the fundamentals of technique which, if mastered, would enable him to produce skiagraphs of a much higher grade of usefulness than those usually seen.

The author is to be commended for the statement on page 10, viz., "Roentgen ray interpretation should never be accepted by a dentist as a diagnosis *per se*," as the skiagraph should be considered as a diagnostic aid only, except in a few cases where it is conclusive. This statement applies equally to the physician. The practice of some radiographers of making unequivocal diagnoses, and even advising the patient as to the character of therapeutic measures, is pernicious and should be discontinued. Such suggestions as these speak well for the value of the book.

Chapter II on normal X-ray, anatomy, variations, and artifacts should be mastered by every one attempting radiography.

Chapter III is equally important as the angle of incidence and the principal ray must be comprehended, and this implies a knowledge of the particular anatomical parts which are prone to conditions of disease.

The author's contention that "Pulpless teeth showing no roentgenographic or clinical evidence of infection can, in the majority of cases, be safely retained in the mouths of patients who show no evidence of systemic disease," is absolutely right and neither physicians nor dentists should order them extracted simply because they may be a potential menace.

The latter half of the book is devoted to very excellent enlarged reproductions of pathological conditions as shown by the radiograph.

The book will be of much value to the technician, physician, and dentist. H. A. POTTS.

BY operative tactics the authors of *Opératoire des Voies Biliaires*[2] include an exact appreciation of the patient's resistance, based upon pre-operative clinical examination; a precise inventory of the lesions and of their severity; a correct exploration of pathological organs, including their connections and particular anatomical characteristics; and, finally, a thorough knowledge of the different technical procedures and of the results one may obtain through their use.

Every possible phase of the subject is closely analyzed. Pre-operative investigations and care, anæsthetics and the various incisions employed, all are gone into very carefully. The illustrations are not always anatomically correct though artistically reproduced; this is particularly true of the classical incisions. One is somewhat surprised to find that the gall bladder is still sutured to the parietal peritoneum in cholecystostomy, a useless and obsolete technique. There is an excellent description of biliary catheterization, duodenotomy, and retrograde catheterization. The last two chapters are devoted to a consideration of postoperative complications and postoperative care.

The book can be highly recommended to the general surgeon with a reading knowledge of French medical terminology. GEORGE DE TARNOWSKY.

INTEREST in spinal anæsthesia, in spite of resistance or indifference on the part of many surgeons, is steadily growing. In reading the excellent monograph on this subject by Charles H. Evans[3] one can but feel that with exact indications, proper drugs, watchful care, and ever ready emergency measures, spinal anæsthesia is a wonderful achievement. The subject of the physiology of symptoms accompanying spinal anæsthesia has never been so comprehensively and lucidly summarized as in this monograph. The importance of understanding the perversions of function during and after spinal anæsthesia is well pointed out. In consequence, the care of the patient becomes fundamentally sound. The contra-indications are enumerated in great detail.

The author describes a method carefully worked out, based on the use of neocaine dissolved in spinal fluid. Adrenalin given intramuscularly maintains the blood pressure. While the use of spinocain advocated by Pitkin is described, its general use is not recommended. That is a noteworthy attitude as most surgeons, who have had experience with crystalline neocaine in spinal fluid, have remarked on the benefit of Pitkin's methods. The reviewer would have welcomed more evidence that the Pitkin method is not suitable for the "beginner or the busy surgeon."

This monograph appears at a most welcome time. Everybody is flying and daily wrecks are reported in the newspapers. Everybody is beginning to be interested in spinal anæsthesia and is using it for minor surgery, with poor or misunderstood indications. Dr. Evans warns of the dangers, emphasizes the complications, and is a safe pilot in the new spinal wave. His book deserves wide distribution.

GÉZA DE TAKATS.

THE spine, as we all know, is a very difficult part of the osseous system to examine even with the X-ray. Drs. George and Leonard have done much

[1] ANNALS OF ROENTGENOLOGY; A SERIES OF MONOGRAPHIC ATLASES. Edited by James T. Case, M.D. Vol. v—Teeth and Jaws Roentgenologically Considered. By Herman A. Osgood, M.D. 2d ed. rev. New York: Paul B. Hoeber, Inc., 1929.

[2] LA TACTIQUE OPÉRATOIRE. Published under the direction of M. Robineau and W. M. Stern. Tactique Opératoire des Voies Biliaires. By W. M. Stern and R. Fourche. Paris: Gaston Doin et Cie, 1929.

[3] SPINAL ANESTHESIA (SUBARACHNOID RADICULAR CONDUCTION BLOCK); PRINCIPLES & TECHNIQUE. Charles H. Evans, M.D. Introduction by W. Wayne Babcock, M.D., F.A.C.S. Foreword by Charles Gordon Heyd, M.D., F.A.C.S. New York: Paul Hoeber, Inc., 1929.

in their book[1] to make the spine at least more comprehensible. Based on an abundance of experience covering many years of careful work they have added a book much needed by all roentgenologists and orthopedists. Unlike many text books this book describes in detail many of the less common diseases that usually are only mentioned in other works of this kind. In this respect the book is of great value as a reference. The subject of anomalies of the vertebrae has been dealt with in detail. This part is of great value, especially to those doing industrial medicine and surgery. The points of differential diagnosis in tuberculosis, arthritis, fractures, and tumors of the vertebra, are of great aid, especially in obscure cases. I am sure careful study of these points will clear up obscure cases which are often of great importance as very frequently these patients are medico-legal cases.

The reproductions are generally good, especially the lateral views which are always difficult to obtain. The book is well prepared and the material is arranged systematically. E. L. J.

THE fourth edition of Hertzler's *Technic of Local Anesthesia*[2] has the good qualities of a monograph written on the basis of long experience with local methods. The book is completely up-to-date and is characterized by sane conservatism toward newer and more complicated methods, which, according to the author, "present rather a hope than an achievement." It is indeed highly constructive to read of the experiences, results, and difficulties of such an experienced surgeon.

In the preparation of novocain solutions, the author dissolves the unsterilized tablets in sterile water. Since the work of Hoffman and Kochmann on the sterility of novocain tablets, this method may occasionally lead to infection. The use of quinine and urea for the prolongation of local anæsthesia is given considerable space. It is a great credit to the author, who for so many years has studied the action of quinine on the tissues, to have restricted the usefulness of this drug to a limited field. Even so, after personal experience, the reviewer is not convinced of the harmlessness of quinine. Further work on the higher quinine derivatives may offer more promise in the future.

The printing and illustrations are excellent. For the general surgeon, who does not always work under the most favorable circumstances, this book will be a reliable guide to simple and safe methods.

Only such a combination as the surgeon himself administering the local anæsthesia will ever lead to helpful and lasting results. The idea of making a specialty of local anæsthesia is most aptly refuted by just such a contribution to the surgical literature as that of Hertzler. GÉZA DE TAKATS.

[1] ANNALS OF ROENTGENOLOGY; A SERIES OF MONOGRAPHIC ATLASES. Edited by James T. Case, M.D. Vol. viii. The Vertebrae, Roentgenologically Considered. By Arial Wellington George, M.D., and Ralph Davis Leonard, M.D. New York: Paul B. Hoeber, Inc., 1929.

[2] THE TECHNIC OF LOCAL ANESTHESIA. By Arthur E. Hertzler, M.D., A.M., Ph.D., LL.D., F.A.C.S. 4th ed. St. Louis: The C. V. Mosby Company, 1928.

WOLFF'S *Shorter Anatomy*[3] is written in the informal classroom style which characterizes a young, progressive, wide awake clinician. There is none of the carefully studied anatomical description with which we are familiar in the standard texts. The subject matter is divided into seven regions, each region being taken up by systems. The descriptive matter is terse and to the point, at times even in outline form, but all clearly understandable. The illustrations are decidedly modernistic except for the omission of color although it is to be regretted that many are of decidedly inferior character and must detract somewhat from one's respect for the book. For purposes of rapid review or for use by the student of surgical anatomy the book would be of value. It would also recommend itself to the clinical teacher of surgery in his classroom work.

MICHAEL L. MASON.

"THIS book is the fruit of ten years of collaboration." With this statement Professors Leriche and Policard introduce their compact monograph on the *Normal and Pathological Physiology of Bone.*[4] Drs. Moore and Key tell us, in the preface of their 236 page authorized translation of this work, that Professors Leriche and Policard have surveyed the "entire fund of knowledge pertaining to bone, condensed it, discarded that which was inaccurate and formed a synthesis of their study and observation which permits one to state the problems which are the foundation of bone physiology." Footnotes are used to express the views of the translators when these differ from those of the original authors.

Osteogenesis is the problem of foremost interest, and after discussing it from many angles, Professors Leriche and Policard, the one a surgeon and the other a professor of microscopic anatomy, express the belief that we must look to the physicist and the chemist for the further solution of this problem.

Bone, they contend, is only the end product of metaplasia or of a metamorphosis of connective tissue. The more adult the connective tissue, the less it is subject to metamorphosis to bone. And "The physiological worth is inversely proportional to the histological differentiation."

With V. Mueller they believe that when bone follows cartilaginous tissue, the process is one of resorption of the cartilage and replacement first with connective tissue and finally with bone. They are convinced that the process is not a transformation and metaplasia but rather a substitution and neoplasia.

The rôle of the osteoblast is discussed at length, and the authors conclude that these cells do not have a true osteogenic function and that while alive they are weakly osteolytic. The osteoblasts which are hemmed in with pre-osseous substance become bone

[3] A SHORTER ANATOMY WITH PRACTICAL APPLICATIONS. By E. Wolff, M.B., B.S. (Lond.), F.R.C.S. (Eng.). New York: William Wood and Company, 1929.

[4] THE NORMAL AND PATHOLOGICAL PHYSIOLOGY OF BONE; ITS PROBLEMS. By R. Leriche and A. Policard. Translated by Sherwood Moore, M.D., and J. Albert Key, M.D. St. Louis: The C. V. Mosby Company, 1928.

cells, but in this they have only a passive rôle. The authors are inclined to give credence to the theory of Robison which suggests that osteoblasts may secrete during life or liberate upon dying, substances which impregnate the fundamental pre-osseous substance and render it fit to fix lime salts.

Professors Leriche and Policard are convinced that calcification takes place in dead tissue and that "new bone is built in part from the débris of old bone." They propound the theory that resorption (rarefaction) of normal bone in the vicinity of a bone defect produces a local calcific surcharge essential to calcification in the new bone. Resorption of bone may be due to the phagocytic action of osteoclasts or to the process of osteolysis, or it may be a combination of the two processes.

The results of a series of experiments of their own have led the authors to consider the periosteum as a commonplace membrane which merely confines and limits bone growth and does not have any osteogenic function of its own.

Some most interesting observations are made under the headings of "The Repair of Fractures"; "Bone Transplantations"; "Heterotopic Ossifications"; and "Ossification and Pathology".

Although many of the theories presented in this thesis will be challenged, the book should accomplish the purpose expressed by the authors and stimulate research in the directions in which they point out knowledge needs to be gained. It is a book which should be read by all who are interested in problems of bone repair. D. B. PHEMISTER.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

TUBERCULOSIS; ITS PREVENTION AND HOME TREATMENT; A GUIDE FOR THE USE OF PATIENTS. By H. Hyslop Thomson, M.D., D.P.H. New York and London: Oxford University Press, 1928.

THE CYTOARCHITECTONICS OF THE HUMAN CEREBRAL CORTEX. By Constantin von Economo. Translated by Dr. S. Parker. New York and London: Oxford University Press, 1929.

DISEASES OF THE LARYNX INCLUDING THOSE OF THE TRACHEA, LARGE BRONCHI AND ŒSOPHAGUS. By Harold Farwell, M.B. (Lond.), F.R.C.S. (Eng.). New York and London: Oxford University Press, 1929.

HÆMORRHOIDS; THEIR ÉTIOLOGY, PROPHYLAXIS AND TREATMENT BY MEANS OF INJECTIONS. By Arthur S. Morley, F.R.C.S. (Eng.). New York and London: Oxford University Press, 1929.

NEPHRITIS; ITS PROBLEMS AND TREATMENT. By T. Izod Bennett, M.D. (Lond.), F.R.C.P. New York and London: Oxford University Press, 1929.

THE ROBERT JONES BIRTHDAY VOLUME; A COLLECTION OF SURGICAL ESSAYS. By Various Authors. New York and London: Oxford University Press, 1928.

ŒSOPHAGEAL OBSTRUCTION; ITS PATHOLOGY, DIAGNOSIS AND TREATMENT. By A. Lawrence Abel, M.S. (Lond.), F.R.C.S. (Eng.). New York and London; Oxford University Press, 1929.

LA STÉRILISATION DE LA FEMME (ETUDE GÉNÉRALE). By Doctor René Lauriac. Alger: Pfeiffer and Assant, 1929.

LA COXITE GONOCOCCIQUE. By Marthe Lamy. Paris: Gauthier-Villars et Cie, 1929.

ORTHOPEDIC SURGERY. By Sir Robert Jones, Bart., K.B.E., C.B., Ch.M. (Liverpool), F.R.C.S. (Eng., Ire. and Edin.), F.A.C.S. (U.S.A.), and Robert W. Lovett, M.D., F.A.C.S. New York: William Wood & Company, 1929.

ARCHIVOS DA FUNDACAO GAFFRÉE E GUINLE; PUBLICADOS PELA TECHNICA. Composta Dos Profs. Dr. Carlos Chagas e Dr. Ed. Rabello e Dr. G. da Moura Costa. Secretario, Dr. Gastac Cruls. Rio de Janeiro: Fundacao Gaffrée Guinle, 1928.

THE AMERICAN ILLUSTRATED MEDICAL DICTIONARY. By W. A. Newman Dorland, A.M., M.D., F.A.C.S., with the collaboration of E.C.L. Miller, M.D. Philadelphia and London: W. B. Saunders Company, 1929.

SURGICAL DISEASES OF CHILDREN; A MODERN TREATISE ON PEDIATRIC SURGERY. By Samuel Walter Kelley, M.D., LL.D., F.A.C.S. Vols. i and ii. St. Louis: The C. V. Mosby Company, 1929.

STONE AND CALCULOUS DISEASE OF THE URINARY ORGANS. By J. Swift Joly, M.D. (Dub.), F.R.C.S. (Eng.). St. Louis: The C. V. Mosby Company, 1929.

SOME PRINCIPLES OF MINOR SURGERY. By Zachary Cope, M.S., M.D. (Lond.), F.R.C.S. (Eng.). New York: Oxford University Press, 1929.

THE PRINCIPLES OF ELECTROTHERAPY AND THEIR PRACTICAL APPLICATION. By W. J. Turrell, M.A., D.M., B.Ch. (Oxon.), D.M.R. & E. (Cantab.). 2d ed. New York: Oxford University Press, 1929.

ARTIFICIAL SUNLIGHT AND ITS THERAPEUTIC USES. By Francis Howard Humphris, M.D. (Brux.), F.R.C.P. (Edin.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), L.M. (Rot., Dublin), D.M.R. & E. (Cantab.). New York: Oxford University Press, 1929.

GASTRO-INTESTINAL DISEASES: Lectures delivered at the James Mackenzie Institute for Clinical Research, St. Andrews, Winter Session, 1927. Edited by Professor David Waterston, M.A., M.D., F.R.C.S. (Edin.). New York: Oxford University Press, 1928.

KER'S INFECTIOUS DISEASES. A PRACTICAL TEXTBOOK. Revised by Claude Rundle, O.B.E., M.D. (Lond.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), D.P.H. 3d ed. New York: Oxford University Press, 1929.

THE TREATMENT OF FRACTURES AND DISLOCATIONS IN GENERAL PRACTICE. By G. Max Page, D.S.O., M.S. (Lond.), F.R.C.S., and W. Rowley Bristow, M.B., B.S. (Lond.), F.R.C.S. New York: Oxford University Press, 1929.

ENDOCRINE DISORDERS. By Professor Hans Curschmann. With an Introduction by Franz Prange. New York: Oxford University Press, 1929.

METHODS AND PROBLEMS OF MEDICAL EDUCATION. Thirteenth Series. By various authors. New York: The Rockefeller Foundation, 1929.

VARICOSE VEINS; WITH SPECIAL REFERENCE TO THE INJECTION TREATMENT. By H. O. McPheeters, M.D., F.A.C.S. Philadelphia: F. A. Davis Company, 1929.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

FRANKLIN H. MARTIN, Chicago, *President* MERRITTE W. IRELAND, Washington, *President-Elect*

CHICAGO EXECUTIVE COMMITTEE

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DALLAS B. PHEMISTER
ALFRED A. STRAUSS

COMPLETE PROGRAM FOR THE CLINICAL CONGRESS IN CHICAGO

THE surgeons of Chicago are preparing and will present during the nineteenth annual Clinical Congress of the American College of Surgeons, beginning Monday, October 14th, and ending Friday, October 18th, a highly attractive program of clinics and demonstrations in the hospitals and medical schools of this city—one that will completely represent the clinical activities of this great medical center in all departments of surgery. A preliminary schedule of such clinics and demonstrations, as prepared by the Committee on Arrangements under the leadership of Dr. Herman L. Kretschmer, chairman, will be found in the following pages. The program as here published may be regarded as an outline of what the clinicians of Chicago intend to present as the hospital schedules will be further revised and amplified during the weeks preceding the Congress.

It will be noted that the program provides for operative clinics and demonstrations beginning at 2 o'clock on Monday afternoon, October 14th, and for each morning and afternoon of the four following days. The real clinical program will be issued daily during the Congress: (1) in the form of bulletins to be posted on bulletin boards at headquarters each afternoon, presenting an accurate and detailed schedule of the clinics and demonstrations to be given at each of the hospitals on the following day; (2) in the form of printed bulletins to be distributed each morning.

Since the last session of the Clinical Congress held in Chicago in 1923 a number of new hospitals have been built and some of the older institutions have been remodeled and enlarged so that there has been a notable increase in Chicago's clinical facilities in keeping with the growth in population. Also, there has been a marked increase in hotel facilities so that it will be possible to accommodate comfortably a much larger number of visiting surgeons at this year's meeting than at any previous session in Chicago. The unusually large number of advance registrations already received at the offices of the College indicates a wide interest in the plans for this year's meeting.

In the clinical program special attention is to be given to the demonstration of modern methods in the treatment of fractures. A series of special fracture clinics will be held at the Cook County Hospital where members of the surgical staff of that institution will give fracture clinics daily. Under the auspices of the College Committee on Fractures, a special series of clinics and demonstrations is being arranged for Tuesday and Wednesday afternoons at Cook County Hospital at which clinics several members of the Committee living outside of Chicago have been asked to participate and demonstrate special methods used in the more difficult fracture cases.

In addition to an attractive program of clinics and demonstrations in the hospitals and medical schools provided by the ophthalmologists and otolaryngologists, covering all phases of surgical work in these specialties, the officers of the Chicago Ophthalmological and Chicago Laryngological societies have arranged for a joint sesssion with a dinner on Wednesday evening at the Stevens Hotel to which are invited all those

attending the Congress who are interested in these specialties. Mr. Herbert Tilley, of London, one of the outstanding otolaryngologists of Great Britain will speak on "The Tonsils and Some Experiences of Their Surgical Treatment," and Dr. Harold Gifford, of Omaha, on "Clinical Miscellany." Major Norman Imrie, instructor in American history at the Culver Military Academy, will talk on "Here and There."

In addition to the clinics and demonstrations to be given by the surgeons of Chicago, a series of special clinical demonstrations has been arranged for Tuesday and Wednesday afternoons to be given in the ballroom of the Stevens Hotel. A complete detailed program for these sessions will be found in the following pages.

An important feature of this year's Congress will be the showing of a number of surgical films that have been produced under the supervision of and approved by the Board on Medical Motion Picture Films. Several such films will be given their premier showing in Chicage. A rather extensive program of motion picture films to include other surgical films is planned.

Among the distinguished guests of the Clinical Congress who will be introduced at the Monday evening session are Dr. D. P. D. Wilkie, professor of surgery in the University of Edinburgh, Scotland; Professor James Heyman, one of the active staff members of the Radiumhemmet, Stockholm, Sweden; Dr. T. de Martel, an eminent surgeon of Paris, France; Dr. Florestan Aguilar, physician in ordinary to the King of Spain and member of the faculty of the University of Madrid.

HEADQUARTERS

General headquarters for the Congress will be established at the Stevens Hotel, located on Michigan Avenue between Seventh and Eighth Streets, where the grand ballroom, other smaller ballrooms and large public rooms on the second, third, and fourth floors have been reserved for the exclusive use of the Congress for scientific meetings, hospital conferences, motion picture exhibitions, committee rooms, executive offices, etc. The registration desk will be located in the large exhibition hall at the south end of the hotel in which room will also be found the bulletin boards, ticket bureaus, and the scientific and technical exhibits. All of the evening meetings are to be held in the grand ballroom which will also be used for the hospital conferences on Monday, clinical demonstrations on Tuesday and Wednesday afternoons, the annual meeting on Thursday afternoon and the conferences on traumatic surgery on Friday morning and afternoon.

EVENING MEETINGS

The complete programs for the five evening sessions as arranged by the Executive Committee of the Clinical Congress will be found in the following pages. All of these meetings will be held in the grand ballroom of the Stevens Hotel. At the Presidential Meeting on Monday evening, the president-elect, Major General Merritte W. Ireland, surgeon-general of the United States Army, will be inaugurated and will deliver the annual address. The Murphy oration in surgery will be delivered on the same evening by Professor D. P. D. Wilkie, of Edinburgh, Scotland. At the Convocation on Friday evening, the Fellowship address will be delivered by Dr. Glenn Frank, president of the University of Wisconsin.

HOSPITAL CONFERENCE

The twelfth annual hospital conference of the American College of Surgeons opens on Monday morning at 9:30 in the grand ballroom of the Stevens Hotel, with an afternoon session in the same room. On the following days the sessions will all be held in the north ballroom on the third floor. The complete program for the conference is published in the following pages. It provides an interesting series of papers, discussions, round table conferences, and demonstrations dealing with many of the problems related to hospital efficiency, and is planned to interest not only surgeons but hospital trustees and personnel generally. An invitation to attend is extended to all persons who are interested in hospital activities. Also, all persons attending the conference are urged to avail themselves of the other activities of the Congress, especially to attend the Presidential Meeting on Monday evening and the Convocation on Friday evening.

ANNUAL MEETING—CANCER SYMPOSIUM

The annual meeting of the Fellows of the College will be held at 2 o'clock on Thursday afternoon in the grand ballroom at which time reports of officers and committees will be presented and officers elected for the following year. Immediately following the business session there will be presented the following group of papers:

ROBERT B. GREENOUGH, M.D., Boston; Chairman of the Committee: Report of the Committee on the Treatment of Malignant Diseases with Radium and X-Ray.

BURTON J. LEE, M.D., New York: The Incidence of Cancer in the Indians of the Southwest.

EMIL NOVAK, M.D., Baltimore: The Early Recognition of Cervical Cancer.

DALLAS B. PHEMISTER, M.D., Chicago; Chairman, Committee on Bone Sarcoma: Chondrosarcoma of Bone.

BOWMAN C. CROWELL, M.D., Chicago: Summary of Ewing's Sarcoma in the Register.

CONFERENCE ON TRAUMATIC SURGERY

A conference on traumatic surgery has been arranged for Friday with sessions both morning and afternoon in the grand ballroom of the Stevens Hotel, to which leaders in industry, education, and labor together with representatives of indemnity companies, surgeons, and hospital administrators have been asked to contribute. The program for the conference is as follows:

MORNING SESSION

FREDERIC A. BESLEY, M.D., Waukegan; Chairman, Board on Traumatic Surgery, presiding.

BOWMAN C. CROWELL, M.D., Chicago; Secretary, Board on Traumatic Surgery: Summary of Past and Future Activities of the Board on Traumatic Surgery.

FREDERICK W. SLOBE, M.D., Chicago: Relation of the Doctor to Industry, Hospitals, and Indemnity Companies.

C. F. N. SCHRAM, M.D., Beloit, Wis.; President, American Association of Industrial Physicians and Surgeons: Present Status and Qualifications of the Industrial Surgeon.

C. H. WATSON, M.D., New York; Medical Director, American Telephone and Telegraph Company: Preemployment and Periodic Health Examinations in Industry.

VOLNEY S. CHENEY, M.D., Chicago; Medical Director, Armour & Co.: Organization of an Industrial Medical Department.

GEORGE G. DAVIS, M.D., Chicago; Chief Surgeon, Illinois Steel Company: Transportation of the Injured. Discussion: W. E. DEEKS, M.D., New York; General Manager, Medical Department, United Fruit Company.

CLARENCE D. SELBY, M.D., Toledo, Ohio: Group Medical Service for Small Industries.

IRVIN ABELL, M.D., Louisville; Professor of Clinical Surgery, University of Louisville: Traumatic Surgery in the Curriculum of Medical Schools.

HERBERT C. CLARK, M.D., Panama; Director, Gorgas Memorial Laboratory: Industrial Research in the Tropics.

HART E. FISHER, M.D., Chicago; Chief Surgeon, Chicago Rapid Transit Company: Exhibit of Resuscitation.

AFTERNOON SESSION

FRANKLIN H. MARTIN, M.D., Chicago; Director General, American College of Surgeons: Inspiration and Ideals of the Board on Traumatic Surgery.

E. W. WILLIAMSON, M.D., Chicago; Investigator for the Board on Traumatic Surgery: Summary of Surveys Made by the Board on Traumatic Surgery.

Representation of the American Federation of Labor: Labor's Attitude Toward Industrial Surgery.

F. HIGHLAND BURNS, Baltimore; President, Maryland Casualty Company, and JAMES S. KEMPER, Chicago; President, Lumbermen's Mutual Casualty Company: The Medical Department in Indemnity Companies—Its Value and Its Needs.

LINDSAY ROGERS, New York; Professor of Public Law, Columbia University: Medicine and Compensation Laws.

FREDERIC A. BESLEY, M.D., Waukegan; Chairman, Board on Traumatic Surgery: How the Program of the Board on Traumatic Surgery Accommodates Itself to the Above Problems.

REDUCED RAILWAY FARES

The railways of the United States and Canada have authorized reduced fares on account of the Chicago session of the Clinical Congress so that the total fare for the round trip will be one and one-half the ordinary first-class one-way fare. To take advantage of the reduced rates it is necessary to pay the full one-way fare to Chicago, procuring from the ticket agent when purchasing ticket, a "convention certificate," which certificate is to be deposited at headquarters for the visé of a special agent of the railways. Upon presentation of a viséd certificate to the ticket agent in Chicago not later than October 30th a ticket for the return journey by the same route as traveled to Chicago may be purchased at one-half the one-way fare.

In the eastern, central, and southern states and eastern provinces of Canada, tickets may be purchased between October 10th and 18th; in southwestern and western states between October 9th and 17th, and in the far western states and western provinces of Canada between October 6th and 14th. The return journey from Chicago must be begun not later than October 30th.

The reduction in fares does not apply to Pullman fares, nor to extra fares charged for passage on certain trains. Local railroad ticket agents will supply detailed information with regard to dates of sale, rates, routes, etc. Stop-overs on both the going and return journeys may be had within certain limits.

Full fare must be paid from starting point to Chicago, and it is essential that a "convention certificate" be obtained from the agent from whom the ticket is purchased. These certificates are to be signed by the general manager of the Clinical Congress and viséd by a special railroad agent in Chicago during the meeting. No reduction in railroad fares can be secured except in compliance with the regulations outlined and within the dates specified. It is important to note that the return trip must be made by the same route as that used to Chicago and that the certificate must be deposited at headquarters during the meeting and return ticket purchased and used not later than October 30th.

It will be noted that the arrangement outlined above, extending the return limit to October 30th, allows for an additional twelve days following the close of the Clinical Congress, thus providing an opportunity for visiting other clinical centers in the middle west.

An exception to the above arrangement is to be noted in the case of persons traveling from points in certain far western states and British Columbia, who will be able to purchase round trip summer

excursion tickets which will be on sale up to and including September 30th with a final return limit of October 31st. The summer excursion fare is somewhat lower than the convention fare mentioned above, but is available only in certain of the far western states and British Columbia. Tickets sold at summer excursion rates permit traveling to Chicago via direct route and returning via another direct route with liberal stop-over privileges.

LIMITED ATTENDANCE

Attendance at the Chicago session will be limited to a number that can be comfortably accommodated at the clinics, the limit of attendance being based upon the result of a survey of the amphitheaters, operating rooms, and laboratories in the hospitals and medical schools to determine their capacity for accommodating visitors. Under this plan it will be necessary for those who wish to attend to register in advance.

Attendance at all clinics and demonstrations will be controlled by means of special clinic tickets, which plan provides an efficient means for the distribution of the visiting surgeons among the several clinics, and insures against overcrowding, as the number of tickets issued for any clinic will be limited to the capacity of the room in which that clinic will be given. Clinic tickets will be distributed each morning and may be reserved late on the previous day.

REGISTRATION FEE

A registration fee of $5.00 is required of each surgeon attending the annual Clinical Congress, such fees providing the funds with which to meet the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued, which receipt is to be exchanged for a general admission card at headquarters. This card, which is non-transferable, must be presented to secure clinic tickets and admission to the evening meetings.

CHICAGO HOTELS AND THEIR RATES

In recent years a number of fine large hotels have been built in Chicago, among which is the Stevens with its 3000 guest rooms. Ample first-class hotel facilities are available, many of the hotels being located within short walking distance of the headquarters hotel.

	Minimum Rates with Bath	
	Single Room	Double Room
Auditorium, Michigan Ave. and Congress St.	$3.50	$ 5.00
Belmont, 3100 Sheridan Road	4.00	5.00
Bismarck, 175 W. Randolph St.	3.50	5.00
Blackstone, Michigan Ave. and East 7th St.	5.00	10.00
Chicago Beach, 1660 Hyde Park Blvd.	5.00	5.00
Congress, Michigan Ave. and Congress St.	4.00	6.00
Drake, Michigan Ave. and Walton Place	5.00	6.00
Edgewater Beach, 5349 Sheridan Road	4.00	6.00
Fort Dearborn, Van Buren and LaSalle Sts.	1.95	3.00
Great Northern, Jackson Blvd. and Dearborn	3.50	4.50
Knickerbocker, 163 E. Walton Place	3.00	5.00
Lake Shore Drive, 181 Lake Shore Drive	5.00	7.00
LaSalle, LaSalle and Madison Sts.	3.00	4.50
Morrison, Clark and Madison Sts.	2.50	5.00
Palmer, Monroe and State Sts.	4.00	7.00
Parkway, 2100 Lincoln Park West	3.00	5.00
Pearson, St. Clair and Pearson Sts.	3.50	5.00
Sherman, Clark and Randolph Sts.	3.00	4.00
Stevens, Michigan Ave. and 7th St.	3.50	6.00
Webster, 2150 Lincoln Park West	3.00	5.00

CLINICAL DEMONSTRATIONS

Tuesday, 2 P.M.—Grand Ballroom, Stevens Hotel

J. M. T. Finney, M.D., Baltimore: Surgery of the stomach.

Burton J. Lee, M.D., New York: Tumors of the breast.

Charles H. Mayo, M.D., Rochester, Minn.: Laws of cell growth.

Wednesday, 2 P.M.—Grand Ballroom, Stevens Hotel

George W. Crile, M.D., Cleveland: Influence of the thyroid and of the adrenals in the production and treatment of peptic ulcer.

Walter E. Dandy, M.D., Baltimore: Brain surgery.

John B. Deaver, M.D., Philadelphia: Abdominal surgery.

PROGRAM FOR EVENING MEETINGS

Presidential Meeting—Monday, 8:15 P.M.—Grand Ballroom, Stevens Hotel

Address of Welcome: HERMAN L. KRETSCHMER, M.D., Chicago, Chairman of Committee on Arrangements.

Address of Retiring President: FRANKLIN H. MARTIN, M.D., Chicago.

Introduction of Foreign Guests.

Inaugural Address: Surgery in the Medical Department of the United States Army. MAJOR GENERAL MERRITTE W. IRELAND, Washington.

The John B. Murphy Oration in Surgery: Some Principles in Abdominal Surgery. PROFESSOR D. P. D. WILKIE, Edinburgh, Scotland.

Tuesday, 8:15 P.M.—Grand Ballroom, Stevens Hotel

FRANK H. LAHEY, M.D., Boston: Hyperthyroidism Associated with Cardiac Disorders.
Discussion: H. M. RICHTER, M.D., and OSCAR NADEAU, M.D., Chicago

EDWARD W. ARCHIBALD, M.D., Montreal: Dangers Involved in the Operation of Thoracoplasty for Pulmonary Tuberculosis.
Discussion: CARL A. HEDBLOM, M.D., and RALPH B. BETTMAN, M.D., Chicago.

WALTMAN WALTERS, M.D., Rochester, Minn.: A Method of Reducing the Incidence of Fatal Post-operative Pulmonary Embolism.
Discussion: EDWIN M. MILLER, M.D., and VERNON C. DAVID, M.D., Chicago.

Wednesday, 8:15 P.M.—Grand Ballroom, Stevens Hotel

JAMES HEYMAN, M.D., Stockholm, Sweden: Radiology as a Complete or Partial Substitute for Surgery in the Treatment of Cancer of the Female Pelvic Organs.
Discussion: ARTHUR H. CURTIS, M.D., and HENRY SCHMITZ, M.D., Chicago

WILLIAM B. HOLDEN, M.D., Portland, Oregon: The Surgical Treatment of Intestinal Obstruction.
Discussion: FREDERIC A. BESLEY, M.D., J. A. WOLFER, M.D., and L. R. DRAGSTEDT, M.D., Chicago.

CHARLES L. SCUDDER, M.D., Boston: Oration on Fractures.

Thursday, 8:15 P.M.—Grand Ballroom, Stevens Hotel

THIERRY DE MARTEL, M.D., Paris, France: The Status of Local Anæsthesia in Neurologic Surgery.
Discussion: ALLEN B. KANAVEL, M.D., and LOYAL DAVIS, M.D., Chicago.

A. W. ADSON, M.D., Rochester, Minn.: Surgical Indications for Sympathetic Ganglionectomy and Trunk Resection in the Treatment of Chronic Arthritis. (In collaboration with LEONARD G. ROWNTREE, M.D.)
Discussion: LEWIS J. POLLOCK, M.D., and STEPHEN W. RANSON, M.D., Chicago.

Symposium: Pernicious Anæmia.

GEORGE H. WHIPPLE, M.D., Rochester, N. Y.: Physiological Background of the Treatment of Pernicious Anæmia by Diet Factors.

C. C. STURGIS, M.D., Ann Arbor, Mich. The Treatment of Pernicious Anæmia by Liver Feeding.

WILLIAM P. MURPHY, M.D., Boston: Newer Developments of Liver Feeding in Cases of Anæmia; Liver Feeding in Diseases of the Liver.

Discussion: CHARLES A. ELLIOTT, M.D., and A. C. IVY, M.D., Chicago.

Convocation—Friday, 8:15 P.M.—Grand Ballroom, Stevens Hotel

Conferring of Honorary Fellowships.

Presentation of Candidates for Fellowship, Class of 1929.

Presidential Address: The Medical Department of the United States Army. MAJOR GENERAL MERRITTE W. IRELAND, Washington.

Fellowship Address: DR. GLENN FRANK, President of the University of Wisconsin, Madison.

PRELIMINARY CLINICAL PROGRAM

GENERAL SURGERY, GYNECOLOGY, OBSTETRICS, UROLOGY, ORTHOPEDICS

PASSAVANT MEMORIAL HOSPITAL—NORTHWESTERN UNIVERSITY MEDICAL SCHOOL

Monday

2.—Symposium on Diseases of the Liver and Bile Passages

CHARLES A. ELLIOTT. Some medical aspects of biliary disease.

WALTER H. NADLER. Hypoglycæmia of hepatic origin associated with primary liver cell carcinoma.

PAUL STARR. Practical methods of determination of liver function.

J. T. HART and R. C. CRAIN. The spinal cord pathway of afferent impulses from the gall bladder.

J. R. BUCHBINDER. Surgical indications in the doubtful gall bladder.

JAMES T. CASE. An evaluation of cholecy tography based upon findings at operation.

E. L. WALSH and A. C. IVY. Studies on the solubility of human gall stones bearing on the etiology.

Tuesday

H. M. RICHTER—9. Cholecystectomy, cholelithiasis.

LOYAL DAVIS—9. Trigeminal neuralgia.

A. H. CURTIS and G. H. GARDNER—9. Operative gynecology.

2.—Symposium on the Diagnosis and Surgical Treatment of Diseases affecting Muscle Function

S. W. RANSOM. Studies in muscle tone.

L. J. POLLOCK. Muscle tone in Parkinsonian states.

LOYAL DAVIS. The surgical treatment of Parkinson's disease.

Wednesday

ALLEN B. KANAVEL—9. Thyroid surgery.

J. R. BUCHBINDER—9. Thyroid surgery.

2.—Symposium on Diseases of the Thyroid Gland

J. G. CARR. Cardiac disease associated with hyperthyroidism.

C. A. ELLIOTT. The management of patients with hyperthyroidism.

H. M. RICHTER. The surgical indications in hyperthyroidism.

LAWRENCE JACQUES. Irradiated ergosterol in the treatment of postoperative tetany.

ALLEN B. KANAVEL and J. J. LEBOWITZ. The late results of thyroidectomy.

Thursday

H. M. RICHTER—9. Thyroid surgery.

LOYAL DAVIS—9. Brain tumor.

A. H. CURTIS and G. H. GARDNER—9. Operative gynecology.

2.—Symposium on Surgery of the Hand

ALLEN B. KANAVEL. Presentation of cases—tendon suture, arthroplasty, Dupuytren's contraction, tenoplasty.

M. L. MASON and C. G. SHEARON. Tendon suture—an experimental study.

SUMNER L. KOCH. Acquired contractures of the hand.

Friday

ALLEN B. KANAVEL—9. Dupuytren's contraction.

SUMNER L. KOCH and M. L. MASON—9. Tendon transplantation.

(Note —Morning clinics at Passavant Memorial Hospital, afternoon clinics at Northwestern University Medical School.)

ALBERT MERRITT BILLINGS HOSPITAL

Monday

LESTER DRAGSTEDT—2. Abdominal surgery, intestinal obstruction.

Tuesday

PERCIVAL BAILEY—9. Surgery of the spinal cord.

D. B. PHEMISTER, L. DRAGSTEDT, G. M. CURTIS, and C. B. HUGGINS—9. Surgical operations.

Wednesday

D. B. PHEMISTER—9. Surgery of bones and joints.

P. BAILEY, G. M. CURTIS, L. DRAGSTEDT, and C. B. HUGGINS—9. Surgical operations.

Thursday

G. M. CURTIS—9. Surgery of the thyroid.

D. B. PHEMISTER, P. BAILEY, L. DRAGSTEDT, and C. B. HUGGINS—9. Surgical operations.

Friday

C. B. HUGGINS—9. Genito-urinary surgery.

D. B. PHEMISTER, P. BAILEY, G. M. CURTIS, and L. DRAGSTEDT—9. Surgical operations.

RESEARCH AND EDUCATIONAL HOSPITAL

Tuesday

CARL A. HEDBLOM—10. Thoracic and general surgery.

Wednesday

JEROME R. HEAD—10. Neurological surgery.

F. H. FALLS—2. Gynecology and obstetrics.

H. B. THOMAS—2. Orthopedic surgery.

Thursday

J. D. KOUCKY—10. General surgery.

CHARLES MCKENNA—2. Genito-urinary surgery.

Friday

LINDON SEED—9. Thyroid surgery.

LOUIS SCHULTZ—10. Oral surgery.

F. H. FALLS—2. Gynecology and obstetrics.

CHICAGO LYING-IN HOSPITAL

Monday

JOSEPH B. DELEE—2. Motion pictures of laparotrachelotomy.

Tuesday

D. A. HORNER and L. E. NADELHOFFER—9. Obstetrical clinic.

A. R. LAPHAM—2. Obstetrical clinic.

Wednesday

J. P. GREENHILL and M. E. DAVIS—9. Obstetrical clinic

Thursday

E. L. CORNELL and M. P. URNES—9. Obstetrical clinic.

Friday

J. H. BLOOMFIELD and H. BUXBAUM—9. Obstetrical clinic.

COOK COUNTY HOSPITAL
(including the Children's Hospital)

Monday

SUMNER L. KOCH. Surgery of the hand; general surgery.
GEORGE L. APFELBACH. Surgical complications of diabetes.
FREDERICK G. DYAS. Thyroid disease; carcinoma of the breast.
FREDERICK FALLS. Obstetrical operations.
GEORGE DAVENPORT. General surgery.
FRANK JIRKA. General surgery.
PAUL OLIVER. General surgery.
CHARLES PARKER. General surgery.

Tuesday

HARRY CULVER. Genito-urinary surgery.
CHARLES M. MCKENNA. Urological clinic.
R. W. MCNEALY. General surgery.
KELLOGG SPEED. Tumors of bone; fractures of carpal bones.
HARRY JACKSON. Injuries to the brain.
D. C. STRAUSS. Thyroid surgery.
R. T. VAUGHAN. General surgery.
EDWARD M. MILLER. Toxic thyroid disease in children; purpura hæmorrhagica.
RICHARD JAFFE—11. Pathological conference.
CHARLES L. SCUDDER (Boston), M. S. HENDERSON (Rochester), W. C. CAMPBELL (Memphis), P. D. WILSON (Boston)—2. Fracture clinic.

Wednesday

HENRY SCHMITZ. Inflammation of the pelvic organs; carcinoma of the pelvic organs.
PHILIP H. KREUSCHER. Osteomyelitis; congenital deformities; arthroplasty of hip and elbow.
V. L. SCHRAGER. General surgery.
SUMNER L. KOCH. Surgery of the hand; general surgery.
J. R. BUCHBINDER. Thyroid surgery.
WILLIAM O'NEILL SHERMAN (Pittsburgh), E. L. ELIASON (Philadelphia), COL. W. E. KELLER (Washington), FRED C.COTTON (Boston)—2. Fracture clinic.

Thursday

CHANNING W. BARRETT. Gynecological clinic.
KARL A. MEYER. Gastric surgery.
WILLIAM R. CUBBINS. Fracture clinic.
CHARLES DAVISON. General surgery.
JOHN R. HARGER. Acute osteomyelitis.
D. S. HILLIS. Obstetrical clinic.
A. F. LASH. Treatment of puerperal infection.
EDWARD M. MILLER. Fractures about the elbow in children.
RICHARD JAFFE—11. Pathological conference.

Friday

CAREY CULBERTSON. Gynecological clinic.
VERNON C. DAVID. Carcinoma of large bowel.
GEORGE DE TARNOWSKY. General surgery.
J. R. BUCHBINDER. General surgery.
A. E. KANTER. Gynecological operations.
E. L. CORNELL. Complications of pregnancy and labor.
FREDERICK G. DYAS. Thyroid disease; carcinoma of the breast.
FREDERICK FALLS. Obstetrical clinic.

Days and Hours to Be Announced

PHILIP LEWIN, CHARLES PARKER, DANIEL LEVINTHAL, FREDERICK TEST, MARCUS HOBART, PHILIP H. KREUSCHER. Orthopedic operations and demonstration of cases.

GARFIELD PARK HOSPITAL

Monday

J. M. BERGER—2. Thyroid clinic, operations and demonstration of cases.
J. R. HARGER—2. Bone transplant; nerve and tendon suture.
CARL BAUER—3. Diagnosis and management of sterility; radium treatment of carcinoma of the cervix.
P. S. SCHMITT—3. Pathological presentations.

Tuesday

FRANK D. MOORE—9. Surgery of the upper abdomen.
THEODORE TEIKEN—9. The medical aspects of the abdominal case.
F. L. BROWN—2. Gall-bladder surgery.

Wednesday

C. C. ROGERS—9. Operative treatment of cranial injuries.
L. F. MACDIARMID—9. Surgery of the abdomen.
VINCENT J. O'CONOR—2. Two-stage suprapubic prostatectomy.
BEVERIDGE MOORE—2. Orthopedic surgery.

Thursday

VICTOR SCHRAGER—2. Surgical treatment of ulcer of the stomach.
C. WELDY—2. Surgery of the gall bladder.
R. H. GOOD—2. Thoracic surgery.

Friday

G. G. FOUSER—9. Surgery of the thyroid.
H. L. BAKER—9. Abdominal surgery.
H. N. WAIT—9. Roentgenology.

ILLINOIS CENTRAL HOSPITAL

Tuesday

HUGH MACKECHNIE—9. Dry clinic: General surgery.
CHARLES H. PHIFER—10. Infections of the upper abdomen.
FARIS CHESLEY—11. Medical aspects of the acute abdomen.

Wednesday

W. T. HARSHA—9. Dry clinic: General surgery.
LEROY H. SLOAN—10. Medical aspects of toxic goiter.
A. H. BAUGHER—11. Pathology of toxic goiter.

Thursday

J. C. DELPRAT—9. Dry clinic: General surgery.
STEPHEN C. HOGAN—10. Gynecological clinic.
WILLIAM CULPEPPER—11. X-ray demonstration of pathology of Paget's disease, lues and metastatic tumors.

Friday

W. T. HARSHA and C. C. GUY—9. Dry clinic: General surgery.
BEVERIDGE MOORE—10. Orthopedic surgery.
WILLIAM HEWITT—11. Dry clinic: Gynecology and obstetrics.

WASHINGTON BOULEVARD HOSPITAL

Tuesday

ARTHUR R. METZ—9. Fracture clinic.

Wednesday

VINCENT J. O'CONOR—9. Urological clinic.

Thursday

PAUL C. FOX—9. Gynecological clinic.

PRESBYTERIAN HOSPITAL

Tuesday

A. D. BEVAN and associates—9. General surgical operations.
A. D. BEVAN, DR. GATEWOOD, and R. C. BROWN—9. Gall-bladder surgery.
HERMAN L. KRETSCHMER—9. Urological surgery.
R. H. HERBST—9. Urological surgery.
V. C. DAVID—9. General surgical operations.
CARL DAVIS—9. General surgical operations.
N. SPROAT HEANEY, CAREY CULBERTSON, A. E. KANTER, E. D. ALLEN, and C. P. BAUER—9. Gynecological and obstetrical clinics.
W. C. THOMAS—10:30. Blood chemistry and postoperative care.
A. D. BEVAN, DR. DAVIS, and V. C. DAVID—Surgery of the large bowel.
A. H. MONTGOMERY—12. Intussusception.

Wednesday

A. D. BEVAN and associates—9. General surgical operations.
HERMAN L. KRETSCHMER—9. Urological surgery.
N. SPROAT HEANEY, CAREY CULBERTSON, A. E. KANTER, E. D. ALLEN, and C. P. BAUER—9. Gynecological and obstetrical clinics.
WILBUR POST—10:30. Medical preparation of poor surgical risks for surgery.
KELLOGG SPEED—11. General surgical operations; knee joint cases.
E. MILLER—9. General surgical operations.
A. D. BEVAN, DR. DAVIS, E. M. MILLER, and DR. LORING—11. Surgery of the thyroid.
ISABELLE HERBST—11:40. Anæsthesia in goiter surgery.

Thursday

A. D. BEVAN and associates—9. General surgical operations.
HERMAN L. KRETSCHMER—9. Urological surgery.
R. H. HERBST—9. Urological surgery.
V. C. DAVID—9. General surgical operations.
KELLOGG SPEED—9. Bone surgery.
E. M. MILLER—9. Posterior dislocation of the shoulder.
A. H. PARMELEE—9. Diagnosis of acute osteomyelitis.
V. C. DAVID—9. Regeneration of bone in osteomyelitis.
R. C. WOODYATT—9. Preparation of diabetics for surgery.
GEORGE F. DICK—9. Erysipelas.
PETER BASSOE and W. J. POTTS—9. Charcot joints.
A. H. MONTGOMERY—9. Treatment of burns.
N. SPROAT HEANEY, CAREY CULBERTSON, A. E. KANTER, E. D. ALLEN, and C. P. BAUER—9. Gynecological and obstetrical clinics.
H. A. OBERHELMAN—11. Surgical pathology.

Friday

A. D. BEVAN and associates—9. General surgical operations.
A. D. BEVAN, DR. GATEWOOD, R. C. BROWN, D. P. ABBOTT, and C. G. GRULEE—9. Surgery of the stomach.
HERMAN L. KRETSCHMER—9. Urological clinic.
CARL DAVIS—9. General surgical operations.
N. SPROAT HEANEY, CAREY CULBERTSON, A. E. KANTER, E. D. ALLEN, and C. P. BAUER—9. Gynecological and obstetrical clinics.
E. E. IRONS—10:30. Relation of focal infection to surgery.
DR. GATEWOOD—11. Subphrenic abscess.
FREDERICK MOOREHEAD—11:20. Surgery of the mouth and face.

ST. JOSEPH'S HOSPITAL

Tuesday

FRANK DAVID and C. J. DEBERE—9. Rectal surgery.
W. H. G. LOGAN—9. Oral surgery.
CHARLES M. MCKENNA—9. Genito-urinary surgery.
HUGH MCKENNA, OSCAR OFNER, DAVID FITZGERALD and GEORGE FITZGERALD—9. General surgery.
CHARLES SCHOTT—9. Results of Rammstedt operation for pyloric stenosis in infants.

Wednesday

FRANK DAVID and C. J. DEBERE—9. Rectal surgery.
F. B. MCCARTY, E. P. CARROLL and JOHN BOLAND—9. General surgery.
W. F. GROSVENOR, H. BUXBAUM, L. W. MARTIN, T. J. O'DONOGHUE, F. W. ROHR, and G. COTTS—11. Gynecology.

Thursday

FRANK DAVID and C. J. DEBERE—9. Rectal surgery.
W. H. G. LOGAN—9. Oral surgery.
CHARLES M. MCKENNA—9. Genito-urinary surgery.
HUGH MCKENNA, OSCAR OFNER, DAVID FITZGERALD and GEORGE FITZGERALD—9. General surgery.
L. E. HINES—9. Demonstration of laboratory work as applied to surgery.

Friday

F. B. MCCARTY, E. P. CARROLL and JOHN BOLAND—9. General surgery.
W. F. GROSVENOR, H. BUXBAUM, L. W. MARTIN, T. J. O'DONOGHUE, F. W. ROHR, and G. COTTS—11. Gynecology.

SPECIAL FRACTURE CLINICS

(At Cook County Hospital, Arranged by the Committee on the Treatment of Fractures)

Tuesday

CHARLES L. SCUDDER, Boston (Chairman of Committee)—2. The aims and work of the Fracture Committee.
M. S. HENDERSON, Rochester, Minn.—2:30. Non-union after fracture, massive bone graft, lantern slide demonstration and patients.
W. C. CAMPBELL, Memphis, Tenn.—3:30. Reduction by closed manipulation of fracture of the shaft of the femur, two cases.
P. D. WILSON, Boston—4:15. Operation: Subastragular arthrodesis for fracture of the os calcis.

Wednesday

FRED C. COTTON, Boston—2. Artificial impaction for fracture of neck of femur, two cases.
WILLIAM O'NEIL SHERMAN, Pittsburgh—2:45. Plating for fracture of shaft of femur.
E. L. ELIASON, Philadelphia—3:30. Pathologic fractures.
COLONEL W. E. KELLER, Washington—4. Old fracture dislocation at the shoulder.

RUSH MEDICAL COLLEGE

Tuesday

CARL DAVIS—11. Surgical clinic.

Wednesday

N. S. HEANEY—11. Gynecological clinic.

Thursday

A. D. BEVAN—11. Surgical clinic.

Friday

CARL DAVIS—11. Surgical clinic.

WESLEY MEMORIAL HOSPITAL

Monday

M. T. GOLDSTINE—2. Hysterectomy, vaginal plastics.

Tuesday

G. DE TAKATS—9. Exclusion of tail of pancreas in diabetes; thyroidectomy, local anæsthesia.
GUY S. VAN ALSTYNE—9. General surgery.
LOYAL DAVIS—2. Brain surgery.

Wednesday

R. W. MCNEALY—9. Hernia and blood vessel surgery.
ALLEN B. KANAVEL—9. General surgery.
JOHN A. WOLFER—9. Duodenal stasis and periduodenitis.
P. B. MAGNUSON and WILLIAM A. HENDRICKS—2. Plastic on hip; spinal fusion.

Thursday

ALLEN B. KANAVEL—9. General surgery.
EUGENE B. PERRY—9. Cystoplasties and kidney surgery.
O. S. PAVLIK—10. Hysterectomy and ovarian transplantation.
V. D. LESPINASSE—2. Genito-urinary surgery.

Friday

R. W. MCNEALY—9. General surgery.
J. J. GILL—10. Obstetrical surgery; pathological obstetrics.
M. C. ERLICK—2. Hysterectomy, ovarian cysts.
P. B. MAGNUSON and WILLIAM A. HENDRICKS—2. Plastic on hip; spinal fusion.

WEST SIDE HOSPITAL

Tuesday

C. R. G. FORRESTER and H. C. LYMAN—9. Fracture clinic. local anæsthesia in reduction of fractures.
E. M. BROWN—11. Surgery of gastric and duodenal ulcers.
P. C. GEORGAN—2. Abdominal surgery, management of intestinal obstruction.

Wednesday

J. S. NAGEL—9. Prostatectomies; demonstration of functional tests in renal surgery; neoplasms of the kidney.
G. F. THOMPSON—9. Surgery of the bile tracts.
S. G. WEST—11. Vaginal hysterectomy; vaginal route in pelvic surgery.

Thursday

C. R. G. FORRESTER and H. C. LYMAN—9. Results of air insufflation in treatment of sequela of cranial injuries; operative treatment of recent and old bone and joint injuries.
C. C. O'BYRNE—11. Goiter clinic.
A. M. HARVEY and J. H. CHIVERS—2. Industrial surgery.

Friday

A. N. CLAGGETT—9. Radium in the treatment of malignant disease, demonstration of cases.
C. G. SCHNETZER—11. Genito-urinary surgery: Cystoscopies, renal catheterization and X-ray demonstration; treatment of hydronephrosis.

ALEXIAN BROTHERS' HOSPITAL

EDWARD WILLIAM WHITE, EDWARD F. HESS, A. J. WOCHINSKI, C. O. RITCH, J. M. GLASSER and ALF. J. HOLM—9, daily. Genito-urinary clinic.
M L. HARRIS, A. G. ZIMMERMAN, and DANIEL MURPHY —9, daily. General surgical clinic.
RALPH WHEELER, L. M. MUNSON, WILLIAM J. SWIFT, FRANK BAYLOR, and K. I. STEVENS—9, daily. Fracture clinic.

JOHN B. MURPHY HOSPITAL

Monday

HENRY R. KENNY. Surgery of bones and joints; arthrodesis of the knee.
WILLIAM GEHL. Renal function test; urological surgery.
F. H. KAMPF. Hallux valgus.

Tuesday

M. J. PURCELL. Fracture clinic.
GUSTAV BRANDLE. Operative treatment of cranial injuries.
A. C. SLINDE. Conservative surgery for hydronephrosis.
S. S. MCNEIL. Plastic operations on hand and face.

Wednesday

ARNOLD H. KEGEL. Thyroid clinic, operation and demonstration of cases.
E. V. J. YOUNG. Operative treatment of old fracture of the os calcis.
JAMES LARKIN. Radium treatment of carcinoma of cervix.

Thursday

WILLIAM GEHL. Two-stage suprapubic prostatectomy.
JOSEPH CUNNINGHAM. Management of the eclamptic patient.
JOHN WALLNER. Diagnosis and management of sterility.
J. WILSON GRIMES. Surgical treatment of pulmonary tuberculosis.
L. C. MCDERMOTT. Cæsarean section.

Friday

A. C. GARVEY. Surgical treatment of ulcers of the stomach.
J. M. HAMILTON. Surgery of the nervous system.
F. O. BOWE. Tendon grafting.
JAMES J. MCGUINN. Carcinoma of the colon and sigmoid.
J. E. LEO. Surgery of the gall bladder and common duct.

SHRINERS' HOSPITAL

Monday

B. H. MOORE—2. Ward visit: demonstration of apparatus in use.

Tuesday

B. H. MOORE—9. Orthopedic operations; use of ethylene anæsthesia for children.
MR. DREHER—2. Demonstration of braces and special apparatus.

Wednesday

B. H. MOORE and associates—2. Demonstration of plaster technique.

Thursday

B. H. MOORE—9. Orthopedic operations.
B. H. MOORE—2. Moving pictures.

Friday

B. H. MOORE—9. X-ray demonstration of unusual conditions.
B. H. MOORE—2. Results in orthopedic cases.

ST. LUKE'S HOSPITAL

L. L. MCARTHUR, S. W. MCARTHUR, H. E. JONES, C. A HEDBLOM, SAMUEL PLUMMER, and W. B. FISK—9, daily. General surgical clinics.
LOUIS SCHMIDT and HARRY CULVER—9, daily. Genito-urinary clinics.
E L. RYERSON, PHILIP LEWIN, R. O. RITTER, F. A. CHANDLER, and H. B. THOMAS—9 daily. Orthopedic clinics.
ARTHUR H. CURTIS and H. O. JONES—2, daily. Gynecological clinics.

MERCY HOSPITAL

Monday

R. S. BERGHOFF—2. Differential diagnosis of chest diseases.
JOSEPH LAIBE—2. Urologic surgery; the relation of urology to gynecology.
P. H. KREUSCHER—2. Congenital dislocation of the hip; injection treatment of varicose veins.

Tuesday

L. D. MOOREHEAD—9. Surgery of the thyroid gland: Exophthalmic goiter, toxic adenoma, parenchymatous goiter, and mixed type of goiter.
J. F. GOLDEN—9. Abdominal surgery.
F. C. JACOBSEN—9. Fractures in industrial surgery.
J. B. O'DONOUGHUE—2. Tumors of breast, their surgical significance; clinical significance of reverse peristalsis of the upper intestinal tract, particularly in reference to gastrojejunal anastomosis; reaction of different classes of thyroid cases to surgery, and treatment of some unusual complications.
C. L. MARTIN—2. Polyps of the rectum and sigmoid; tuberculous ulcers of the sigmoid and rectum.

Wednesday

C. F. SAWYER—9. Pancreatitis—acute, subacute, and chronic; types of intestinal obstruction.
M. F. MCGUIRE—9. Treatment of diseases of the gall bladder and bile ducts; carcinoma of the colon.
J. E. KELLEY—9. The acute abdomen.
HENRY SCHMITZ—2. Early diagnosis and treatment of uterine and mammary cancers. Diagnosis and treatment of sterility due to blocked uterine tubes.
M. C. MULLEN—2. Toxemias of pregnancy.

Thursday

P. H. KREUSCHER—9. Treatment of advanced scoliosis; fractures involving the knee joint; fractures of the hip.
F. E. PIERCE—9. Fracture clinic.
F. M. DRENNAN, L. E. GARRISON, and C. F. SAWYER—2. Joint discussion on duodenal pathology with presentation of cases and the results of some experimental work; consideration of œsophageal stenosis by Dr. Drennan.
M. MANDEL—2. Pernicious anæmia.

Friday

HENRY SCHMITZ—9. Gynecological surgery.
GEORGE GRIFFIN—9. Gastro-intestinal surgery.
J. D. CLARIDGE—9. Dislocation of internal semilunar cartilage.
W. S. BARNES—2. Gynecological clinic.
W. J. PICKETT—2. Fascial suture in the repair of hernia.
A. V. PARTIPILO—2. Closed aseptic gastro-intestinal anastomosis.
B. B. BEESON—2. Dermatological conditions which may become surgical.

UNITED STATES VETERANS HOSPITAL

(Edward Hines Jr. Hospital, Hines, Ill.)

Thursday

CARL A. HEDBLOM—9. Operations: Thoracoplasty (two cases); phrenicoexeresis.
PAUL F. BROWN—10:30. Thyroidectomy; gastro-enterostomy.
PHILIP H. KREUSCHER—1:30. Operation for chronic osteomyelitis.
ROBERT O. RITTER—2:30. Spinal fusion.
JOHN S. COULTER—3:30. Demonstration in physical therapy.

UNIVERSITY HOSPITAL

Tuesday

ADOLPH KRAFT—9. Suppuration about the diaphragm.
GEORGE M. LANDAU—10. Pathological aspects of the lung from a roentgenological standpoint.
MAX MEYEROVITZ—11. Surgical conditions of Meckel's diverticulum.

Wednesday

HARRY SINGER—9. Demonstration of gastro-intestinal specimens.
KARL A. MEYER—10. Gastro-intestinal surgery.

Thursday

ARTHUR H. CONLEY—9. Calcium and phosphorous metabolism in fractures.
CHARLES DAVISON—10. Surgery of autogenous bone transplants.

Friday

O. H. ROHRLACK—9. Surgical obstetrics.
MARSHALL DAVISON—10. Surgery of undescended testes.

WASHINGTON PARK COMMUNITY HOSPITAL

Tuesday

C. C. CLARK—9. Thyroid operation; carcinoma of breast.
H. H. COX—9. Cholecystectomy; hemorrhoids.
Y. JORANSON—2. Blood transfusion; spinal anæsthesia.
F. P. HAMMOND—2. Hernia, recurrent and ventral; management of fracture about ankle.

Wednesday

S. C. HOGAN—9. Gastric resection; gall-bladder surgery.
L. B. BELL—9. Cholecystectomy; posterior gastro-enterostomy.
H. H. COX—2. Hysterectomy; carcinoma of breast; thyroid.
C. C. CLARK—2. Hernia; gastro-enterostomy.

Thursday

F. P. HAMMOND—9. Osteomyelitis; empyema.
Y. JORANSON—9. Goiter; gastro-enterostomy.
E. B. PERRY—10. Epididymotomy; bladder tumor.
L. B. BELL—2. Appendectomy; hemorrhoidectomy.
S. C. HOGAN—2. Hysterectomy; thyroid.

TRAUMATIC SURGERY CLINICS

(In the offices of the Medical Director of the Lumbermen's Mutual Casualty Co., 4750 Sheridan Road)

Monday

FRED J. COTTON, Boston—2. Treatment of ununited fractures.
J. H. SHORTELL, Boston—3. Treatment of fractures of the tibia.
PAUL B. MAGNUSON—3:30. Fractures, extent of permanent disability.

Tuesday

DENNIS R. W. CRILE—2. Ruptured brachial plexis; results of musculo-spiral nerve suture.
WILLIAM M. HARSHA and G. V. PONTIUS—3. Trauma to abdomen; removal of spleen; carcinoma of stomach.
L. P. KUHN—4. Report of 74 cases of trauma to abdomen with immediate operation in 27; extent of permanent disability.

Wednesday

PHILIP H. KREUSCHER—2. Knee joint injuries.
EDWIN W. RYERSON—3. Back injuries, extent of permanent disability.

Thursday

SIDNEY WALKER—9:30. Traumatic eye cases.
LOYAL DAVIS—10:30. Skull fractures.
LEROY THOMPSON—11:30. Traumatic eye cases.

MICHAEL REESE HOSPITAL

Tuesday

ALFRED A. STRAUSS—9. Stomach resection for gastric and duodenal ulcer; blood transfusion and resection of colon.
GEORGE DAVENPORT—9. General surgery; surgery of the central nervous system.
IRVIN S. KOLL—9. Pyelotomy for stone; nephrectomy for kidney tumor; urethral plastics.
JULIUS E. LACKNER—9. Abdominal hysterectomy; interposition operation; rectovaginal fistula.
W. H. RUBOVITS—9. Obstetrical clinic, demonstration of forceps, version and complete suture, episiotomy.

Wednesday

D. C. STRAUSS—9. Thyroid surgery.
W. W. HAMBURGER—9. Masked hyperthyroidism.
RALPH B. BETTMAN—9. Thoracoplasty, phrenicotomy, internal pneumolysis.
J. S. EISENSTAEDT—9. Undescended testes and prostatectomy.
CHARLES M. JACOBS and DANIEL LEVINTHAL—9. Orthopedic surgery.
L. E. FRANKENTHAL, SR.—9. Gynecological operations.

Thursday

EMANUEL FRIEND—9. Gall-bladder surgery.
HELIODOR SCHILLER—9. General surgery; treatment of extensive carbuncle.
JOSEPH L. BAER—9. Complete perineal laceration, ovarian tumor and pelvic inflammation.
IRVING STEIN—9. Obstetrical demonstration, low cervical cæsarean under local anæsthesia.
GUSTAV KOLISCHER—9. Bladder tumors.
HARRY C. ROLNICK—9. Prostatectomy.

Friday

ALFRED A. STRAUSS—9. Gastric resection for carcinoma and gall bladder surgery.
HARRY JACKSON—9. Bone tumors and osteomyelitis.
HARRY KATZ—9. Diverticulum of bladder.
ALFRED E. JONES—9. Spinal anæsthesia and prostatectomy.
JULIUS E. LACKNER and W. H. RUBOVITS—9. Sturmdorf-Wertheim operation for carcinoma of the cervix, plastic repair.
JOSEPH L. BAER and IRVING STEIN—9. Prolapse; vaginal hysterectomy; fibroids; occiput posterior

MOUNT SINAI HOSPITAL

Tuesday

V. L. SCHRAGER—9. Abdominal surgery with special reference to interpretation and management of surgical risks.

Wednesday

I. E. BISKOW—9. Abdominal surgery.
A. E. KANTER—9. Vaginal plastics; hysterectomies.

Thursday

V. L. SCHRAGER—9. Abdominal surgery with special reference to interpretation and management of surgical risks.
L. HANDELMAN—9. General surgical operations.

Friday

J. MORA and B. A. WILLIS—9. Goiters; fractures.
M. BERNSTEIN—9. Orthopedic surgery: Synovectomies of knee; spinal fusion.

CHICAGO MEMORIAL HOSPITAL

Monday

VANCE RAWSON—2. Cardiovascular disease and surgery.
CHARLES J. DRUECK—3. Diverticulitis.

Tuesday

ARTHUR E. MAHLE—9. Management of the thyroid patient.
PETER S. CLARK—9. Surgery of the thyroid.
JULIA C. STRAWN—2. Surgical gynecology.
JAMES E. FITZGERALD and M. RUTH MCGUIRE—3:30. Surgical obstetrics.

Wednesday

BENNETT R. PARKER—9. Surgery of the gall bladder and bile tract.
J. W. PARKER—9. Hydronephrosis and hypernephroma.
FRANK WRIGHT and ALBERT ZRUNEK—10. Demonstration of humoral colloids; relation of the colloids of the plasma to surgical problems.
ROBERT A. MELENDY—2. Empyema and allied conditions.
GEORGE L. BROOKS and ROBERT A. MELENDY—4. Surgery in diabetics.

Thursday

CHARLES E. KAHLKE—9. Surgery of the stomach and duodenum.
PAUL M. CLIVER—2. Fractures—general management, operation, treatment and results.
CHARLES J. DRUECK—3. Unusual rectal fistulas.
M. L. WEINSTEIN—4. Gall-bladder surgery under local anæsthesia.

Friday

LAWRENCE L. ISEMAN—9. The cancer problem.

SOUTH SHORE HOSPITAL

Monday

FREDERICK RAHE—2. General surgical clinic.
ETHELBERT LUTTON—3. General surgical clinic.

Tuesday

HUGH MACKECHNIE—9. General surgical clinic.
LOUIS D. SMITH—11. Genito-urinary surgery.
MARTIN MERBIT —2. General surgical clinic.

Wednesday

GUY VAN ALSTYNE—9. General surgical clinic.
GEORGE G. O'BRIEN—11. General surgical clinic.
EDMOND PROBY—2. General surgical clinic.

Thursday

WELLER VAN HOOK—9. General surgical clinic.
AXEL WERELIUS—10:30. General surgical clinic.
EDWARD MASTERTON—2. General surgical clinic.

Friday

FRANK MEAD—9. General surgical clinic.
PAUL ROSBOROUGH—10. General surgical clinic.
FRANK MURPHY—11. Fracture clinic.
LESLIE BLACKWOOD—2. General surgical clinic

GRANT HOSPITAL

Tuesday

A. G. FREY—9. General surgical clinic.
A. G. ZIMMERMAN—11. General surgical clinic.

Thursday

A. G. ZIMMERMAN—11. General surgical clinic.

Friday

S. COOMBS—9. General surgical clinic.

ILLINOIS MASONIC HOSPITAL

Tuesday

ROBERT H. HAYES, HERMAN H. COLE and GEORGE L. DAVENPORT—9. Surgical treatment of pulmonary or chest conditions.
B. H. HUGGINS—10. Arthritis.
JOHN R. HARGER and C. K. TIMMONS—10:30. Surgical aspect of peptic ulcers.
WILLIAM A. BRAMS—11:30. Medical aspect of peptic ulcers.

Wednesday

E. W. WHITE—9. Genito-urinary clinic.
HUGH MACKECHNIE, BAYARD HOLMES and JOHN F. DAVIS—10. Adhesive pericarditis with establishment of collateral circulation, operation; demonstration of tribromo-ethyl rectal anæsthesia; thyroid surgery; gastroenterostomy under paravertebral block and splanchnic block.

Thursday

W. H. GILMORE—9. X-ray as an aid in pelvimetry; pelvic trauma, demonstration.
GILBERT FITZPATRICK—9:30. Operative obstetrics; estimation of the surgical risk in toxemias of pregnancy.
HAROLD MILLER—10:10. Uterine displacements and their influence at puberty.
SIGMUND KRUMHOLZ—10:30. Trigeminal neuralgia.
JOHN P. SPRAGUE, WALTER R. FISCHER and JOHN E. DAVIS—10:40. Sarcoma of humerus; result of sunlight and recumbent treatment of tuberculosis of the spine in a patient 47 years of age; interesting orthopedic cases.

Friday

W. H. GILMORE—9. Technique of roentgenological examination and treatment of the thymus gland in childhood.
C. A. ALDRICH—9:15. Thymic symptom in childhood.
CHARLES SCHOTT—9:30. Thymus in relationship to cleft palate and hair lip.
MAURICE L. BLATT—9:45. Thymus and its treatment.

ST. MARY OF NAZARETH HOSPITAL

Tuesday

L. M. CZAJA—9:30. Fracture clinic.

Wednesday

R. E. FLANNERY—9. Traumatic surgery.
T. Z. XELOWSKI—10. Abdominal surgery.

Thursday

J. WELFELD—9. Prostatic surgery.
D. A. ORTH—10. Breast surgery.

Friday

W. A. KUFLEWSKI—9. Traumatic surgery.
GEORGE MUELLER—10:30. Abdominal surgery.

LUTHERAN MEMORIAL HOSPITAL

Tuesday

CHARLES F. STOTZ—9. General surgical clinic.

Wednesday

ARTHUR G. FREY—9. General surgical clinic.

Thursday

CHARLES F. STOTZ—9. General surgical clinic.

Friday

ARTHUR G. FREY—9. General surgical clinic.

AUGUSTANA HOSPITAL

Tuesday

NELSON M. PERCY—9. Thyroid clinic; general abdomina surgery; spinal anæsthesia.
R. J. ODEN—9. General surgery.

Wednesday

O. E. NADEAU—9. General and urological surgery.
J. W. NUZUM—9. General surgery.
E. H. OCHSNER—9. General surgery.
D. W. CRILE—10. Orthopedic surgery.

Thursday

NELSON M. PERCY—9. Thyroid clinic; general abdomina surgery; spinal anæsthesia.
R. J. ODEN—9. General surgery.

Friday

O. E. NADEAU—9. General and urological surgery.
J. W. NUZUM—9. General surgery.
E. H. OCHSNER—9. General surgery.
D. W. CRILE—10. Orthopedic surgery.

ST. BERNARD'S HOSPITAL

Monday

WILLIAM EPSTEIN—2. Goiter clinic.
G. M. CUSHING—2. Gall-bladder clinic.

Tuesday

WILLIAM HECTOR—9. Surgical clinic.
L. B. DONKLE—9. Surgical clinic.
CHESTER GUY—2. Laboratory demonstrations.
J. A. PARKER—2. Surgical clinic.

Wednesday

J. B. HAEBERLIN—9. Surgical clinic.
EMIL RACH—2. Obstetrical clinic.
B. C. CUSHWAY—2. Radium cases.

Thursday

J. T. MEYER—9. Surgical clinic.
W. H. BOHART—9. Industrial surgery.
J. G. FROST—2. Fracture clinic.

JACKSON PARK HOSPITAL

Tuesday

ARRIE BAMBERGER, A. HENNING, C. MACDONALD, and associates—9. General surgery.
S. B. MACLEOD—2. Traumatic surgery.

Wednesday

ARRIE BAMBERGER, A. HENNING, C. MACDONALD, and associates—9. General surgery.

Thursday

ARRIE BANBERGER, A. HENNING, C MACDONALD, and associates—9. General surgery.

Friday

S. B. MACLEOD—2. Traumatic surgery.

HENROTIN MEMORIAL HOSPITAL

Tuesday

CHANNING W. BARRETT—9. Gynecological clinic.

Wednesday

WILLIAM M. THOMPSON—2. Management of abdominal and pelvic adhesions.

WOMEN AND CHILDREN'S HOSPITAL

Tuesday

ELOUISE PARSON and KATHERINE K. TRUE—9. Lipiodol visualization of the uterine and tubal cavities.
PEARL M. STETLER—9. Watkins-Wertheim opration.
CONSTANCE O'BRITIS—9. General surgical operations.
HELEN FLYNN—2. Dry clinic: Treatment of carcinoma of the uterus, breast and intestines, Flynn method.
MARY E. WILLIAMS—2. Dry clinic: Treatment of carcinoma of the cervix and uterus with radium.
MARGARITE H. AUSTIN—2. Dry clinic: Cardiograms and heart cases.

Wednesday

MARIE ORTMAYER—9. Cystoscopic demonstrations.
ANNA BLOUNT—9. General surgical operations.
RACHELLE YARROS—2. Social hygiene in relation to obstetrics and gynecology.
GIRY OTIS—2. X-ray demonstration.
JOHANNA HEUMANN—2. Pediatric cases.
CLARA OCHES—2. Twilight sleep demonstration, obstetrical cases.

Thursday

JOSEPHINE MCCOLLUM—9. Demonstration of various types of anæsthesia, methylene, nitrous oxide, chloroform and ether.
ALICE CONKLIN—9. Hernia operations.
BERTHA BUSH—9. General surgical operations.
BERTHA VAN HOOSEN—2. Dry clinic: Hypertension in pregnancy.
WALBURGA L. KACIN—2. Twilight sleep demonstration, obstetrical cases.

Friday

PEARL M. STETLER—9. Thyroidectomy.
JULIA STRONG—9. Gynecological operations.
EFFIE L. LOBDELL—9. Studies in sterility with demonstration of cases.
LENA K. SADLER—9. Laparotomy.
ALICE CONKLIN—9. Hysterectomy for fibroid.

CHILDREN'S MEMORIAL HOSPITAL

Monday

JOHN A. GRAHAM—1. The acute abdomen.

Tuesday

JAY IRELAND—11. The treatment of empyema in children.

Wednesday

FREDERICK B. MOORHEAD—9. Cleft lip and cleft palate; cartilage transplants for the correction of facial deformities.

Thursday

ALBERT H. MONTGOMERY—9. Pyloric stenosis and intussusception; general surgery of children.

ST. ANTHONY DE PADUA HOSPITAL

Tuesday

LAWRENCE RYAN, FRED EHRMANN, STEPHEN DONLON, and JOSEPH ZABORTSKY—9. General surgical operations.
OTTO J. HIRSA—9. Genito-urinary surgery.
L. S. TICHY—9. X-ray demonstration.

Thursday

JOHN SPRAFKA, FRED OLLENTINE, FRANK JIRKA, and RALPH CUPLER—9. General surgical operations.
HARRY SMIJKL—9. Genito-urinary surgery.
MAX WEISKOPF—9. Obstetrics.
L. S. TICHY—9. X-ray demonstration.

RAVENSWOOD HOSPITAL

Monday

G. W. GREEN—2. Gallstone clinic.
G. N. BUSSEY—2. Abdominal hysterectomy, fibroids.
G. DE TARNOWSKY—2. Hæmorrhagic colitis.

Tuesday

C. A. BUSWELL—9. Carcinoma of the cervix uteri.
D. B. POND—9. Fracture clinic.
R. E. DYER—9. Fallopian tube visualization with lipiodol.
W. F. GROSVENOR, C. C. RENTFRO, and F. W. ROHR—2. Obstetrical conference.

Wednesday

E. B. WILLIAMS—9. Abdominal hysterectomy, fibroids.
P. J. SARMA—9. Abdominal wall incisions based on physiologic grounds.
F. VON NAHOWSKI—9. Hepatic abscess.

Thursday

L. WILDER—9. Goiter cases.
E. W. MUELLER—9. Treatment of burns.
W. F. GROSVENOR, C. C. RENTFRO, and F. W. ROHR—2. Obstetrical conference.
G. DE TARNOWSKY—9. Ruptures of urinary bladder.

Friday

G. W. GREEN—9. Surgical clinic.
A. G. SCHROEDER—9. Surgical clinic.

COLUMBUS HOSPITAL

Monday

FREDERICK MUELLER—2. Orthopedic surgery.

Tuesday

M. J. SEIFERT and D. RUPP—9. Gastric surgery.
L. GRIES—11. Postoperative use of physiotherapy.
H. C. DAVIS—2. Epiphysitis.

Wednesday

D. A. ORTH—9. Abdominal and breast surgery, followed by talk by I. F. VOLINI on their medical aspects.

Thursday

WILLIAM and LENA SADLER—9. Gynecological surgery.
WILLIAM A. SIMUNICH—11. Obstetrical demonstration.

LAKE VIEW HOSPITAL

Tuesday

H. P. SAUNDERS—9. Surgery of the gall bladder, demonstration of cases.
B. C. CORBUS—2. Bladder tumors.

Wednesday

ANDRE L. STAPLER—2. Thyroidectomies, toxic adenoma, with spinal block; hysterectomies, fibroids, with spinal anæsthesia.

Thursday

JOHN W. BIRK—9. Obstetrical clinic, presentation of pathological cases.
WALTER S. SIEWERTH—2. Surgical correction of pathology of female genitalia.

Friday

C. I. WYNEKOOP—9. Surgery of the abdomen, demonstration of cases.

FRANCES E. WILLARD HOSPITAL

Monday

F. G. DYAS. Surgical treatment of ulcer of the stomach and duodenum.
J. S. NAGEL. Surgery of hydronephrosis.
J. W. CARR. Management of the eclamptic patient.
A. H. C. GOLDFINE. Radium treatment of carcinoma of the cervix.
GEORGE J. RUKSTINAT. Pathological demonstration.

Tuesday

VICTOR L. SCHRAGER. Surgery of the abdomen.
F. A. MACKOWIAK. Treatment of Pott's fracture.
H. CULVER. Urological surgery.

Wednesday

FRANK D. MOORE. Surgery of the gall bladder, operations and demonstration of cases.
JOHN R. HARGER. Tendon grafting and suturing.
M. S. COFFLER. Renal function test in urological surgery.
LUDVIG HEKTOEN. Pathological demonstration.

Thursday

A. E. STEWART and MILTON OCHS. Operative treatment of cranial injuries.
OTIS M. WALTER and S. BIEZES. Thyroid clinic.
E. S. BLAINE. Roentgenology.

Friday

J. P. JAROS. Thyroid clinic.
G. F. THOMPSON. Fracture clinic.
J. A. VALENTINE. Emergency surgery.

MUNICIPAL TUBERCULOSIS SANITARIUM

Thursday

CARL A. HEDBLOM—9:30. Surgery of the chest in tuberculosis, operative clinic and demonstration of end-results.

Friday

CHARLES M. MCKENNA—9:30. Tuberculosis of the kidney, operative clinic and demonstration of pathologic types of renal tuberculosis.
BENJAMIN GOLDBERG and associates—2. Special measures in the general care of surgical tuberculosis.

NORTH CHICAGO HOSPITAL
(At Grant Hospital)

Tuesday

FREDERICK HARVEY—9. Fracture clinic, with special reference to fractures about the ankle and elbow.

Wednesday

CARL BECK—9. Plastic surgery of the hands and fingers

Thursday

FREDERICK HARVEY—9. Thyroid clinic.

Friday

CARL BECK—9. Hypospadias.

POST GRADUATE HOSPITAL

Tuesday

L. GLASSMAN—9. Prolapse of the uterus.
W. SCHAARE—10. Colles fracture.

Wednesday

LEO ZIMMERMAN—10. Vascular diseases of the extremities.
W. A. N. DORLAND—2. Repair of perineum.

Thursday

H. L. MEYERS—9. Hysterectomy.
R. W. HARDON—10. Injection treatment of varicose veins.
EMIL RIES—2. Enterocele vaginalis.

Friday

EMIL RIES—10. Precancerous lesions of cervix uteri.
M. MABEE—2. Treatment of leucorrhea.

EVANGELICAL DEACONESS HOSPITAL

Tuesday

EDWARD M. HEACOCK—9. Operative treatment of uterine fibroids.

Wednesday

A. J. SCHOENBERG—9. Carcinoma of the cervix uteri.
F. O. BOWE—2. Placenta prævia and management of its complications.

Thursday

C. V. BACHELLE—9. Operations for ulcer of the stomach and duodenum.
L. H. FRIEDRICH—2. Management of the complications of gonorrhœa.

Friday

PAUL F. MORF—9. Gall-bladder disease and its operative treatment.
ELMER W. MOSLEY—2. Cæsarean section in contracted pelves.

LUTHERAN DEACONESS HOSPITAL

Tuesday

JOHN D. KOUCKY—9. General surgical clinic, operation and demonstation of cases.
LINDON SEED—9. Thyroid clinic, operations and demonstration of cases.
GEORGE H. SCHROEDER—9. General surgical clinic, operations and demonstration of cases.

Thursday

JOHN D. KOUCKY—9. General surgical clinic, operations and demonstration of cases.
LINDON SEED—9. Thyroid clinic, operations and demonstration of cases.
GEORGE H. SCHROEDER—9. General surgical clinic, operations and demonstration of cases.

SURGERY OF THE EYE, EAR, NOSE, AND THROAT

RESEARCH AND EDUCATIONAL HOSPITAL

Monday

FRANCIS L. LEDERER and OSCAR VAN ALYEA—2. Otolaryngological clinic.
JOHN J. THEOBALD—2. Functional testing of hearing.

Tuesday

NATHAN SCHNECK—10. Otolaryngological clinic.
SHERMAN SHAPIRO and ARTHUR J. COOMBS—2. Otolaryngological clinic.
FRANCIS L. LEDERER—2. Borderline otolaryngological operations (face plastics, jaw resection, mastoids, and endoscopy).

Wednesday

JACQUES HOLLINGER—9:30. Diseases of the labyrinth; presentation of specimens; methods of examination, diagnosis, and treatment.
I. G. SPIESMAN—10. Otolaryngological clinic.
FRANCIS L. LEDERER and JOHN J. THEOBALD—2. Otolaryngological clinic.
WALTER THEOBALD—2. Lipiodol in the diagnosis of sinus disease.

Thursday

JACQUES HOLLINGER—9:30. Diseases of the labyrinth; presentation of specimens; methods of examination, diagnosis, and treatment.
GEORGE S. LIVINGSTON—10. Otolaryngological clinic.
SHERMAN SHAPIRO and ARTHUR J. COOMBS—2. Otolaryngological clinic.
JOHN J. THEOBALD—2. Routine otolaryngological operations.

Friday

JACQUES HOLLINGER—9:30. Diseases of the labyrinth; presentation of specimens; methods of examination, diagnosis, and treatment.
J. HARNED—10. Otolaryngological clinic.
FRANCIS L. LEDERER—2. Otolaryngological clinic; diagnosis and treatment of the commoner conditions.

MERCY HOSPITAL

Monday

DENO O'CONNOR and MACOLM JOHNSON—1. Ear, nose and throat clinic.

Tuesday

LOUIS HOFFMAN—9. Ophthalmological clinic.

Wednesday

ULYSSES GRIM—9. Radical antrum, radical mastoid.

Thursday

GEORGE JORDON and CARL CHRISTOPH—9. Ear, nose and throat clinic, bronchoscopy and laryngoscopy.

Friday

GEORGE MUSGRAVE and associates—9. Ear, nose and throat clinic, including demonstration and X-ray illustrations of technique and use of lipiodol in ethmoidal and sphenoidal diagnosis.

CHILDREN'S MEMORIAL HOSPITAL

Tuesday

MORRIS COTTLE—9. Surgical and non-surgical ear diseases in infancy.

ILLINOIS EYE AND EAR INFIRMARY

Monday

MAYER H. LEBENSOHN and EDWARD H. GARRAGHAN—2. Plastic surgery of eyelids.
U. J. GRIM—2. Mastoid.

Tuesday

HERBERT S. WALKER—2. Ocular muscles.
MICHAEL GOLDENBURG—2. Some late phases of glaucoma.
OSCAR CLEFF—2. Mastoid.
CHARLES F. YERGER—2. Radical nasal sinus operations.

Wednesday

DWIGHT C. ORCUTT and ROBERT H. BUCK—2. Ocular muscles and operative trachoma.
HENRY BOETTCHER—2. Tonsils and mastoids.

Thursday

EPHRAIM K. FINDLEY—2. Cataract operations.
EDWARD N. SCHOOLMAN—2. Bronchoscopy and plastic surgery.

Friday

E. R. CROSSLEY—2. Cataract operations.
ALFRED LEWY—2. Nasal sinuses and mastoid.

NORTHWESTERN UNIVERSITY MEDICAL SCHOOL

Monday

L. A. SHIPFER and E. E. DILLON. Chronic suppurative otitis media treated with zinc ionization.
JOHN DELPH. Endoscopy.

Tuesday

C. F. BOOKWATER. Demonstration of intranasal tear sac operation.

Wednesday

OTIS MACLAY. Sinus work.
WILLIAM JOYCE. Demonstration of plastic flap used in radical mastoid operation.

Thursday

CHARLES B. YOUNGER. Atrophic rhinitis.

Friday

R. D. RUSSELL. Demonstration of endolymphatic sac and valve.
ELLISON L. ROSS. Vestibular reaction as affected by drugs.

RUSH MEDICAL COLLEGE

Monday

WILLIAM G. REEDER—3. Ophthalmological clinic.

Tuesday

EARLE B. FOWLER—3. Opthalmological clinic.

Wednesday

T. D. ALLEN—2. Ophthalmological clinic.

Thursday

WILLIAM G. REEDER—3. Ophthalmological clinic.

Friday

BERTHA KLEIN—3. Ophthalmological clinic.

PRESBYTERIAN HOSPITAL

Monday

DANIEL HAYDEN—2. Ear, nose and throat clinic.

Tuesday

GEORGE E. SHAMBAUGH and associates—2. Otolaryngological clinic.
WILLIAM H. WILDER and associates—2. Ophthalmological clinic.
EDWIN MCGINNIS—2. Ear, nose and throat clinic.

Wednesday

GEORGE E. SHAMBAUGH and associates—2. Otolaryngological clinic.
WILLIAM H. WILDER and associates—2. Ophthalmological clinic.

Thursday

GEORGE E. SHAMBAUGH and associates—2. Otolaryngological clinic.
WILLIAM H. WILDER and associates—2. Ophthalmological clinic.
EDWIN MCGINNIS—2. Ear, nose and throat clinic.

COOK COUNTY HOSPITAL

Tuesday

CHARLES F. YERGER—2. Ophthalmic surgery.

Wednesday

JAMES P. FITZGERALD—2. Ophthalmic surgery.
S. SALINGER and S. PEARLMAN—2. Diagnostic clinic; nasal plastic surgery.

Thursday

WILLIAM F. MONCREIFF—9. Surgery of glaucoma.
GEORGE W. BOOT—9. Bronchoscopic clinic.

Friday

THOMAS J. GALLOWAY—10. Diathermy and malignancies of the mouth and throat.

POST GRADUATE HOSPITAL

Monday

J. HAYDEN—2. Accessory sinuses.

Tuesday

S. SHER—11. Benign growth of vocal cord.
B. CUSHMAN—2. Trephine for glaucoma.
B. M. WOLIN—3. Septum and tonsils.

Wednesday

E. STEWART—9. Glaucoma.

Friday

SAMUEL H. WIENER—9. Nasal polyps and accessory sinuses.

WEST SIDE HOSPITAL

Wednesday

W. L. NOBLE—9. Surgery of the eye.

Thursday

J. A. CLARK and A. E. LUND—9. Tonsillectomies.

WESLEY MEMORIAL HOSPITAL

Monday

T. P. O'CONNOR—2. Ear, nose and throat clinic, operations.

Tuesday

J. GORDON WILSON—9. Otological surgery.

ST. JOSEPH'S HOSPITAL

J. HOLINGER, AUSTIN A. HAYDEN, E. W. GARDNER, T. E. BLOMBERG, R. H. HENDERSON, and H. A. RAMSER—9, daily, Tuesday to Friday inclusive. Operative clinics and demonstrations in the departments of otolaryngology and ophthalmology, in collaboration with WILLIAM H. BURMEISTER, F. O. FREDRICKSON, BENJAMIN GOLDBERG and LELAND SHAFER of the department of internal medicine; CHARLES SCHOTT, GUSTAVE KAMPMEIER, MAURICE BLATT, and T. P. SALTIEL of the department of pediatrics; L. A. HINES of the department of pathology; and E. W. JENKINSON of the department of radiology.

Pharynx and larynx—Senile tonsillectomy, case histories with results; sutures in the tonsil fossa for control of hæmorrhage; wax molds for graphically illustrating and recording conformation of nasopharynx and posterior nasal choanae; direct laryngoscopy.

Accessory nasal sinus disease—Incidence in adults, children and infants; presentation of case histories and results; lipiodol and percussion and auscultation as a diagnostic aid.

Tear sac disease—External and internal nasal operations.

Nasal fractures—Diagnosis and treatment, photographs and casts for graphic records.

Ear—Demonstration of audiometers (by courtesy of Graybar Electric Co.) for group and individual hearing tests; indications for operation in acute mastoiditis, case histories; Pohlmann's stapedius muscle exercise and results.

J. HOLLINGER—12, daily. Demonstration of microscopic and macroscopic temporal bone specimens.

Moving pictures, lantern slides, and chalk talks will be used to illustrate certain features of the above program.

ILLINOIS CENTRAL HOSPITAL

Tuesday

J. H. MCLAUGHLIN—9. Ear, nose and throat clinic.
H. J. SMITH—9. Emergency surgery of the eye, industrial injuries.

Wednesday

J. H. MCLAUGHLIN—9. Ear, nose and throat operations.
H. J. SMITH—9. Emergency surgery of the eye, industrial injuries.

Thursday

J. H. MCLAUGHLIN—9. Ear, nose and throat clinic.
H. J. SMITH—9. Emergency surgery of the eye, industrial injuries.

Friday

J. H. MCLAUGHLIN—9. Ear, nose and throat operations.
H. J. SMITH—9. Emergency surgery of the eye, industrial injuries.

CHICAGO MEMORIAL HOSPITAL

Monday

RICHARD H. STREET—4. Tonsillectomies under local and general anæsthesia.

Tuesday

ALFRED E. LEWY and RICHARD W. WATKINS—3. Mastoids.
IRVING I. MUSKAT—4. Plastic surgery.

COLUMBUS HOSPITAL

Wednesday

C. O. LINDSTROM—11. Mastoiditis and various types of tonsillectomies.
M. GOLDENBERG—2. Ophthalmic surgery.

Thursday

L. R. MELLIN—2. Plastics on nose.

EYE, EAR, NOSE, AND THROAT HOSPITAL

Monday

P. A. GRAVES—2. Newer refraction methods for myopia; demonstration of cases.
T. S. KAMMERLING—2. Eye clinic.
H. B. FULLER—2. Ear, nose and throat clinic.
IGNAZ SOMMER—4:30. Intracranial relation to ear, nose and throat.

Tuesday

H. B. FULLER and D. C. BROWN—9. Ear, nose and throat surgical clinic.
O. B. NUGENT—11. Surgical treatment of chronic dacrocystitis.
W. A. FISHER—2. Simplified Barraquer operation for cataract extraction.
R. CASTROVIEJO—4. Demonstration of various methods of ophthalmoscopy (simplified Gullstrand, giant Gullstrand, red free light, direct and indirect).

Wednesday

T. S. KAMMERLING and L. SAVITT—9. Ear, nose and throat surgical clinic.
JOSEPH BECK—9. Surgical treatment of carcinoma of the larynx.
O. B. NUGENT—11. Photography as applied to the practice of ophthalmology. Demonstration of making of photographic records in ocular diseases; in plastic surgery. Anterior stereopticon camera; fundus photography; making of lantern slides; photomicroscopy. Motion pictures.
T. S. KAMMERLING—2. Eye clinic.
H. B. FULLER—2. Ear, nose and throat clinic.
IGNAZ SOMMER—4:30. Tuning forks.

Thursday

O. B. NUGENT—9. Cataract clinic: Cataract extraction by simplified Barraquer method; teaching of cataract extraction by motion pictures.
R. CASTROVIEJO—11. Practical demonstration of slit-lamp microscopy.
H. B. FULLER—2. Eye clinic.
T. S. KAMMERLING—2. Ear, nose and throat clinic.
IGNAZ SOMMER, R. CASTROVIEJO, and E. GALLARDO—2. Demonstration of various laboratory methods and the practical application of clinical findings.
R. CASTROVIEJO—4:30. Histopathology.

Friday

H. B. FULLER, T. S. KAMMERLING and O. M. STEFFENSON—9. Ear, nose and throat surgical clinic.
JOSEPH BECK—9. Pathology of the ear, nose and throat.
H. W. WOODRUFF—11. Deep iridectomy for glaucoma; tucking operation for strabismus.
T. S. KAMMERLING—2. Eye clinic.
H. B. FULLER—2. Ear, nose and throat clinic.
IGNAZ SOMMER—4:30. The rôle of the nasal accessory sinuses in nasal diseases.

ILLINOIS MASONIC HOSPITAL

Friday

ALVA SOWERS—10:20. Cataract operation with discussion relative to older and newer methods.
W. R. BOYNTON—10:40. Strabismus, scientific exactness in differential diagnosis and operative treatment of strabismus; exhibit of instruments; demonstration of cases.
MAURICE H. COTTLE—11. Laryngeal paralysis; ventriculocordectomy.
T. J. WILLIAMS—11:20. Otolaryngological clinic.
H. E. TAYLOR—12:20. Tonsillectomies.

MICHAEL REESE HOSPITAL

Monday

M. L. FOLK—2. Diagnosis and treatment of iritis.

Tuesday

SAMUEL J. MEYER—2. Operations for glaucoma.

Wednesday

ROBERT VON DER HEYDT—2. Slit-lamp microscopy of the living eye.

Thursday

S. C. C[illegible]LENWALD—2. Operations for strabismus.

Friday

ROBERT VON DER HEYDT—2. Photography of the anterior segment of the eye.

WOMEN AND CHILDREN'S HOSPITAL

Tuesday

GERTRUDE THOMPSON—9. Tonsillectomies, Beck method

Wednesday

LILLIAN TAYLOR—9. Tonsillectomies, Sluder method.
GEORGIANA D. THEOBALD—9. Cataract operation.
BEULAH CUSHMANN—9. Operation on eye.
IONE F. BEEM—9. Operation for strabismus.

Thursday

ALICE K. HALL—9. Tonsillectomies under local anæsthesia, dissection method.

MOUNT SINAI HOSPITAL

Wednesday

NOAH SCHOOLMAN, JACOB LIFSCHUTZ, and associates—9. Bronchoscopy and lipiodol injections in pulmonary conditions; œsophagoscopy.
NOAH SCHOOLMAN, JACOB LIFSCHUTZ, and associates—2. Lipiodol studies and operations on accessory sinuses; X-ray studies and operations for ear conditions.

LAKE VIEW HOSPITAL

Monday

FRANK J. NOVAK, JR.—2. Suspension laryngoscopy.

Wednesday

ROBERT H. BUCK—9. Demonstration of various eye operations.

EVANGELICAL DEACONESS HOSPITAL

Monday

ARTHUR GEIGER—2. Deflections of the nasal septum.

Tuesday

G. THOMPSEN VON COLDITZ—2. Types of tonsil operations

GARFIELD PARK HOSPITAL

Tuesday

L. B. PHELPS—9. Indications for operative treatment in acute mastoiditis.

GRANT HOSPITAL

Tuesday

O. KRAFT—9. Eye clinic.

RAVENSWOOD HOSPITAL

Friday

A. N. MURRAY and W. J. NOONAN—2. Otolaryngological clinic.

WASHINGTON BOULEVARD HOSPITAL

Tuesday

LINN F. MCBRIDE—2. Nose and throat clinic.

Wednesday

CASSIUS and VIRGIL WESTCOTT—2. Eye clinic.

Thursday

LINN F. MCBRIDE—2. Nose and throat clinic.

ST. LUKE'S HOSPITAL

Tuesday

JOHN A. CAVANAUGH and EDWARD P. NORCROSS. Nose and throat clinics.

Friday

JOHN A. CAVANAUGH and EDWARD P. NORCROSS. Nose and throat clinics.

NORTH CHICAGO HOSPITAL
(At Grant Hospital)

Tuesday

HARRY L. POLLOCK—9. Surgical treatment of acute mastoiditis.

Thursday

HARRY L. POLLOCK—9. Intranasal surgery.

MUNICIPAL TUBERCULOSIS SANITARIUM

Thursday

FRANCIS LEDERER—2. Tuberculosis of the larynx and bronchoscopic demonstrations.

JOHN B. MURPHY HOSPITAL

Monday

G. W. MAHONEY. Emergency surgery of the eye; industrial injuries.

Tuesday

EDWARD GARRAGHAN. Operations for acute glaucoma.

Wednesday

S. SCIARRETTA. Indications for operative treatment in acute mastoiditis.

FRANCES E. WILLARD HOSPITAL

Monday

W. D. BRODE and C. T. CARR. Nose and throat clinic.

Tuesday

FRANK J. NOVAK. Acute mastoiditis.

ALBERT MERRITT BILLINGS HOSPITAL

Monday

D. KATZ—2. Eye clinic.

Thursday

LOUIS BOTHMAN—9. Eye clinic.

ST. MARY OF NAZARETH HOSPITAL

Tuesday

G. MAHONEY and E. ROLING—9. Eye clinic.

Friday

J. J. KILLEEN—10. Septum surgery.

TWELFTH ANNUAL HOSPITAL STANDARDIZATION CONFERENCE

Monday, 9:30—Grand Ballroom, Stevens Hotel

FRANKLIN H. MARTIN, M.D., Chicago, presiding.

Address of Welcome, ARNOLD H. KEGEL, M.D., Chicago; Commissioner of Health.

Introduction of distinguished guests and representatives of national organizations. Surgeon-General MERRITTE W. IRELAND, Washington, President-Elect, American College of Surgeons.

Symposium on Medical and Surgical Economics

Introductory Remarks, FRANKLIN H. MARTIN, M.D., Chicago.

Medical and Surgical Economics from the Standpoint of the Hospital Administrator, C. G. PARNALL, M.D., Rochester, N.Y.; Medical Director, Rochester General Hospital; President, American Hospital Association.

The Relationship of Medicine and Its Aids to the Cost of Medical Care. REV. ALPHONSE M. SCHWITALLA, S.J., Ph.D., St. Louis; Dean, St. Louis University School of Medicine; President, Catholic Hospital Association.

Comments on Nursing and Hospital Costs for Individuals in Moderate Circumstances, WILLIAM J. MAYO, M.D., Rochester, Minn.

Comparison of Medical and Hospital Costs for Individuals in Moderate Circumstances, STEWART R. ROBERTS, M.D., Atlanta; Member, Committee on the Cost of Medical Care.

General Summary, with Special Reference to the Influence of University Diagnostic Clinics, and their Bearing on the Fees of Independent Practitioners. RICHARD R. SMITH, M.D., Grand Rapids; Chairman, Committee of the Michigan State Medical Society to Survey and Study the Problem of Hospital Charity in Michigan Hospitals.

Presentation of Official Report of Hospital Standardization and List of Approved Hospitals for 1929; Twelve Years in Retrospect. MALCOLM T. MACEACHERN, M.D., Chicago; Associate Director, American College of Surgeons, Director of Hospital Activities.

Monday, 2:00—Grand Ballroom, Stevens Hotel

W. W. PEARSON, M.D., Des Moines, presiding.

Open Forum—Nursing. Conducted by ASA S. BACON, Chicago; Superintendent, Presbyterian Hospital.

The Superintendent's Viewpoint of the Nursing Problem. PAUL H. FESLER, Minneapolis; Superintendent, University Hospitals.

How Can We Assure Efficient Nursing Care of the Patient? E. MURIEL MCKEE, Brantford, Ontario; Superintendent, Brantford General Hospital; and SISTER HELEN JARRELL, Chicago; Superintendent of Nurses, St. Bernard's Hospital.

Discussion opened by ADDA ELDREDGE, R.N., Madison; Director, Bureau of Nursing Education, State of Wisconsin.

Staff Conferences. WALTER S. GOODALE, M.D., Buffalo; Superintendent, Buffalo City Hospital.

Discussion opened by John T. BURRUS, M.D., High Point, N. C., Surgeon, High Point Hospital.

Demonstration—Model Staff Conference. By the Staff of Ravenswood Hospital, Chicago.

Tuesday, 9:30—North Ballroom, Stevens Hotel

JOSEPH C. DOANE, M.D., Philadelphia, presiding.

The Accrediting of Surgical Deaths. Ernest Leroi Hunt, M.D., Worcester, Mass.; Surgeon and Director of Surgical Services, Worcester City Hospital.

Discussion opened by JOHN DEJ. PEMBERTON, M.D., Rochester, Minn.; Assistant Professor of Surgery, Mayo Foundation, University of Minnesota Medical School.

Symposium: The Control and Elimination of Infections in Hospitals

Hernia Operations as an Index of Hospital Infections. CHARLES N. COMBS, M.D., Terre Haute, Ind.; Superintendent, Union Hospital.

Discussion opened by SOUTHGATE LEIGH, M.D., Norfolk, Va.; Visiting Surgeon and Gynecologist, Sarah Leigh Hospital and Clinic.

How Can We Determine the Efficiency of the Surgical Mask? IRVING J. WALKER, M.D., Boston; Clinical Professor of Surgery Medical School of Harvard University.

How Can We Assure the Sterility of Catgut? FRANK L. MELENEY, M.D., New York; Department of Surgery, Columbia University.

Discussion opened by SUMNER L. KOCH, M.D., Chicago; Assistant Professor of Surgery, Northwestern University Medical School.

Plumbing in Hospitals as a Source of Infection, and Proposed Safeguards, ARNOLD H. KEGEL, M.D., Chicago; Commissioner of Health.

Organizing for Emergencies, CHARLES F. NEERGAARD, New York; Trustee, Carson C. Peck, Memorial Hospital, Brooklyn.

Tuesday, 2:00—North Ballroom, Stevens Hotel

WALTER H. CONLEY, M.D., New York; presiding.

The Health Inventorium in the Standardized Hospital, FRANKLIN M. MARTIN, M.D., Chicago.

Open Forum—Administrative Problems Relating to the Care of the Patient. Conducted by ROBERT JOLLY, Houston; Superintendent, Baptist Hospital; Trustee, American Protestant Hospital Association.

What Should Be the Hospital Trustee's Reponsibility for the Care of the Patient? How Can the Hospital Trustee know when the Patient is Receiving Efficient Hospital and Medical Service? LOUIS J. MCKENNEY, Highland Park, Mich.; Chairman, Board of Turstees, Highland Park General Hospital.

Discussion opened by JOHN D. SPELMAN, M.D., Pittsburgh; Superintendent, Montefiore Hospital.

What Factors enter into an Efficient Operating Room Service? A. C. GALBRAITH, Toronto; Superintendent, Toronto Western Hospital.

Discussion opened by MAJOR G. SEELIG M.D., St. Louis; Professor of Clinical Surgery, Washington University School of Medicine.

The X-Ray Department in Hospital Management. JOHN E. DAUGHERTY, M.D., Brooklyn; Superintendent, Jewish Hospital.

Discussion opened by EDWARD S. BLAINE, M.D., Chicago; Radiologist, Wesley Memorial Hospital; Director, National Pathological Laboratories.

What is Being Done to Assist the Person of Moderate Means in Securing Adequate and Efficient Hospital and Medical Service? MICHAEL DAVIS, Ph.D., Chicago; Julius Rosenwald Fund.

Discussion opened by HERMAN L. FRITSCHEL, Milwaukee; Superintendent, Milwaukee Hospital.

Wednesday, 9:30—North Ballroom, Stevens Hotel

R. C. BUERKI, M.D., Madison; presiding. Joint Session with the Association of Record Librarians of North America.

Symposium—Increasing the Efficiency of Case Records

The Rôle of the Record Librarian in Maintaining an Efficient Record System in a Hospital. FLORENCE G. BABCOCK, Ann Arbor; Record Librarian, University of Michigan Hospital.

Discussion opened by C. W. MUNGER, M.D., Valhalla; Superintendent, Grasslands Hospital.

Maintaining Efficient Case Records in an Open Hospital. MAJORIE BOULTON, St. Louis; Record Librarian, Jewish Hospital.

Discussion opened by DONALD C. SMELZER, M.D., St. Paul; Superintendent, Charles T. Miller Hospital.

The Value of Accurate Records for the Study of Cancer. MAUD SLYE, Ph.D., Chicago; Associate Professor of Pathology, University of Chicago.

Discussion opened by BOWMAN C. CROWELL, M.D., Chicago; Associate Director and Director of Clinical Research, American College of Surgeons.

The Correlation of the Record Department and Medical Library in the Hospital. STELLA F. WALKER, Chicago, Director, Literary Research Department, American College of Surgeons.

Discussion opened by MARGUERITE SIMMONS, Chicago; Medical Librarian, Ravenswood Hospital, and MAURINE WILSON, Chicago; Record Librarian, Ravenswood Hospital.

The Nurse's Contribution to the Medical Record. T. R. PONTON, M.D., Chicago; Superintendent, Illinois Masonic Hospital.

Discussion opened by LAURA R. LOGAN, R.N., Chicago; Dean, Illinois Training School for Nurses.

General Discussion opened by EDITH M. ROBBINS, Boston; Chief Record Librarian, Peter Bent Brigham Hospital, and A. L. LOCKWOOD, M.D., Toronto; Surgeon, Lockwood Clinic.

Wednesday, 2:00—North Ballroom, Stevens Hotel

Standardization of Surgical Dressings and Materials—Final Report. FREDERIC H. SLAYTON, M.D., Chicago; Director, Hospital Research and Information Department, American College of Surgeons.

Discussion opened by HUGH SCOTT, M.D., Hines, Ill.; Medical Officer in Charge, U. S. Veterans Hospital.

Open Forum—Professional Problems Affecting the Care of the Patient. Conducted by LEWIS A. SEXTON, M.D., Hartford; Superintendent, Hartford Hospital; President-Elect, American Hospital Association.

The Value and Importance of the Hospital Out-Patient Department. IRVING S. CUTTER, M.D., Chicago; Dean, Northwestern University Medical School; Superintendent, Passavant Memorial Hospital.

What Constitutes an Efficient Clinical Laboratory Service for a Hospital? FRANK W. HARTMAN, M.D., Detroit; Pathologist, Henry Ford Hospital.

Discussion opened by OLIVER W. LOHR, M.D., Saginaw, Mich.; Director, Central Laboratory of Saginaw.

What Constitutes an Efficient Anæsthesia Service for a Hospital? WESLEY BOURNE, M.D., C.M., M.Sc., Montreal.

Discussion opened by JOHN LUNDY, M.D., Rochester; Director, Department of Anæsthesia, Mayo Clinic; and ISABELLA HERB, M.D., Chicago; Chief Anæsthetic, Presbyterian Hospital.

A Plan for Increasing the Number of Autopsies. MAURICE DUBIN, Philadelphia; Superintendent, Mount Sinai Hospital.

Discussion opened by FRANK J. NOVAK, JR., M.D., Chicago; Otolaryngologist, Lakeview Hospital.

The Need for Consultations in the Care of the Seriously Ill. GEORGE W. SWIFT, M.D., Seattle; Brain Surgeon, Children's Orthopedic and King County Hospitals.

Discussion opened by FRANK H. LAHEY, Boston; Surgeon, New England Deaconess and New England Baptist Hospitals.

Thursday, 9:30—North Ballroom, Stevens Hotel

Open forum conducted by MALCOLM T. MACEACHERN, M.D., Chicago, Director of Hospital Activities, American College of Surgeons; assisted by ROBERT JOLLY, Houston; Superintendent, Baptist Hospital.

The entire session will be devoted to discussion of questions and problems presented from the floor and not discussed in previous sessions.

Thursday, 2:00—5:00

Demonstrations in hospital planning, construction, equipment, administration and procedures in Chicago hospitals.